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AN EXPEDITION IN THE SOUTHERN LIBYAN DESERT:

A paper read at the Evening Meeting of the Society on 6 January 1936, by

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IT has been said that Egypt is the Nile, and to most Egyptians and visitors to Egypt this is true. A step outside the Nile Valley takes one almost immediately into the unknown, and this must be one of the reasons why the Libyan Desert has proved such a popular field for exploration during the last five or six years. The unknown is surprisingly easy of access; no long and tedious preliminary journey is needed, since in two days by car from Cairo entirely unexplored country can be reached. Moreover Libyan exploration is fairly cheap and can be done by a few enthusiasts largely with their own resources.

Although much work has been done in the Libyan Desert in recent years there remains much to do. The party which set out from Cairo on 14 January 1935 had varied interests—survey, archaeology, such geological work as our limited knowledge of the subject permitted, the study of sand formations, collection of natural history specimens and plants. Its members were the late Colonel G. A. Strutt and Mrs. Strutt, Lieut. R. N. Harding Newman (Royal Tank Corps), M. H. Mason, R. E. McEuen, and myself. The expedition had the approval and the material support, by a grant of money and by the loan of instruments, of this Society. As on many previous occasions the officials of the Egyptian Desert Surveys did all they could to help us, and we are indebted to Staff-Sergt. Taylor of the Royal Tank Corps for his assistance in fitting out the cars.

We used three model 46, 4-cylinder, Ford "pick-ups," with two seats in front and a light box-body of pressed steel, heightened by a wooden framework, behind. The cars were equipped in much the same manner as on Major Bagnold's 1932 expedition,[1] of which Harding Newman and I had been members. On that occasion we had not the advantage of the 9×13-inch Dunlop "airwheels" which we used with such success in 1935. Broadly

[1] See *Geogr. J.*, vol. 82, p. 229, for details.

speaking, desert sand may be divided into three types: (1) That in which no car will stick. (2) That through which it is often possible to force a way by keeping up speed and by intelligent use of the slopes of the ground. (3) That in which any tyre yet made will bog. The use of "airwheels" means that one has less difficulty on sand of the second class; one's immunity from "sticks" is greatly increased. Moreover the large low-pressure tyre acts almost as an additional spring on each wheel, relieving the strain on the car over rough going.

In other matters of supply, such as the method of carrying petrol and water, the quantity and type of food, etc., we followed closely the practice which had proved successful on earlier expeditions with Bagnold and of which full details may be found in the appendices to his paper quoted above. When fully loaded we carried enough water for eighteen days and petrol (for each car) for 1200 miles.

Our first objective was the south-eastern part of the Gilf Kebir plateau and the journey thither up the Nile Valley to Asyut and thence *via* Kharga, Dakhla, and Pottery Hill, calls for no comment. We were anxious to visit one of the recently discovered wadis which cut through the Gilf and which have been explored by the three Claytons, Almasy, and Penderel; a valley with vegetation in so remote and isolated an area might show something of interest to the naturalist. Coming from the east, the Wadi Hamra was the most easily accessible of the three, and this we entered on January 23. The approach to the wadi is guarded by a 5-mile-wide line of dunes which took the best part of a day to cross. In a fairly long experience of Libyan sand-dunes I had never met worse ones than these, though Almasy tells me that an easier crossing may be found a few miles farther south. The dunes lie between the main plateau of the Gilf and an outlier, and thus are not free to arrange themselves according to known types and formations as are the dunes in open country. Confusion is thus worse confounded. The Wadi Hamra, which emerges on the eastern side of the Gilf in lat. 24°, cuts back into the plateau in a south-westerly direction for some 20 miles. It is a narrow, winding valley, half a mile or less wide with steep cliffs 300 feet high and, true to its name, the sand of the bed is red-brown in colour. At the southern end are a few acacias and a little grass. The Gilf here is a flat plateau of blackened sandstone over which a car could easily be driven if it could once be brought up to the top, but from the Wadi Hamra this is impossible. The wadi proved disappointing; the rains of June 1934, which had been heavy at 'Uweinat and had brought life to the vegetation at the south end of the Gilf, had not reached as far north as this. As a result the vegetation had dried and we saw little animal life.

From the Wadi Hamra it was easy to reach the south-east part of the Gilf by cutting through the Gap to the western side and then turning southwards. January 27 found us camped at the extreme southern end near where Penderel and Almasy had erected the memorial tablet to the late Prince Kemal el Din. The eastern face of the Gilf Kebir, from its southern point up to about lat. 23°, is shown on the latest maps as an almost continuous scarp with one unsurveyed and conjectural re-entrant. The expeditions of Kemal el Din in 1926 and Bagnold in 1930 had passed within sight of this scarp, but little or nothing was known of its character, though a flight by Penderel over part of the area

in 1932 [1] had given some idea of what might be expected. During the time we were in this neighbourhood we were able to cover by a network of car traverses an area of 300–400 square miles and to add considerably to the existing knowledge of its topography. I repeat again the simile I have used elsewhere.[2] "It is as though an army of gigantic maggots, advancing from the east, had eaten their way into the plateau as into a flat cheese, stopping just short of its western edge where, near the top of the cliff, is the watershed, for all these valleys drain east."

The whole of this part of the Gilf is cut up by an intricate series of wide sandy valleys, between which stand uneroded portions of the original sandstone plateau. Seen from far out on the plain which slopes gently to its western foot the Gilf presents an unbroken wall of sandstone cliff, 1000 feet high, whose flat summit-line might have been drawn with a ruler. No apparent gap in the cliffs is visible, but coming from the east we found one pass where we could drive down to the western plain and a second where there was certainly an easy descent for cars. Recently—by desert standards, where vegetation retains its vitality for months—rain had fallen in this area and the slopes of the sandy valleys were covered with patches of grass (*Aristida acutiflora*), but we saw no trees. A high-water mark of debris in one of the valley bottoms showed that for an hour or two there had been a running stream. We were surprised to see no mountain sheep or even gazelle, for these desert animals usually succeed in finding the occasional patches of vegetation and in making the most of them.

Every expedition to the Libyan Desert returns with evidence of human habitation in early times. With the discovery of rock paintings by Almasy at 'Ein Dua in 'Uweinat and in the Wadi Sura on the western side of the Gilf as precedents we were hopeful of finding more here. A re-entrant from one of the main valleys sloped up to the plateau level and on the neck between the re-entrant and the next valley north of it McEuen noted a number of small caves or rock shelters. On the back wall of one of these, a small *abri* 40 feet across and 20 feet deep, was an excellent series of paintings. The pictures, some twenty-five in all, are painted in red and white and show a few human figures and a number of animals. The latter appear to be of the species *Bos africanus*, the cattle of Predynastic and Old Kingdom times in Egypt, which were later replaced by *B. brachyceros*. That they were domesticated here is indicated by the collars or halters shown on some, by their spotted coats and by the prominence given to the udders. These paintings are very similar to those at 'Ein Dua, and include another example of a cave or hut with a woman seated inside.[3] The Abbé Breuil, who has kindly examined our copies, considers them to be of Predynastic date, perhaps 5000–4000 B.C.

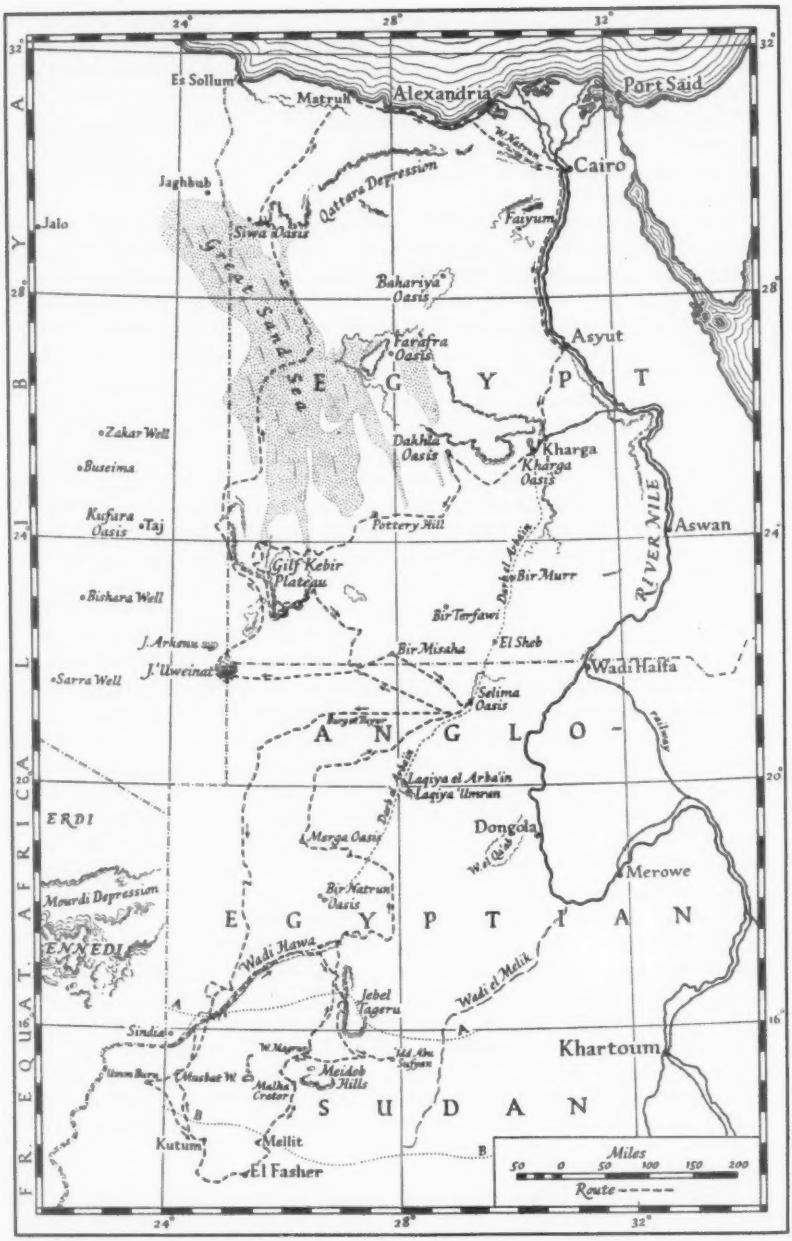
Continuing our winding course through the Gilf we eventually reached the eastern side again. As one goes north the plateau is less cut up by interior valleys and the scarps are higher and more continuous.

The journey from the Gilf across to Selima Oasis calls for little comment.

[1] *Geogr. J.*, vol. 83, p. 451.

[2] *The Times*, 6 August 1935.

[3] *Geogr. J.*, vol. 83, p. 459. A full account of these new paintings will appear in *Antiquity* for June 1936.


Es Sollum
Matruh
Alexandria
Port Said
Cairo
Jaghbub
Jalo
Siwa Oasis
Qattara Depression
Faiyum
Bahariya Oasis
Asyut
Farafra Oasis
Great Sand Sea
EGYPT
Zakar Well
Buseima
Dakhla Oasis
Kharga
Kharga Oasis
Kufara Oasis
Taj
Pottery Hill
Aswan
RIVER NILE
Gilf Kebir Plateau
Bir Murr
Bishara Well
Bir Terfawi
Bir Misaha
El Sheb
J. Arkenu
J. 'Uweinat
Wadi Halfa
Sarra Well
Selima Oasis
ANGLO-
Laqiya el Arba'in
Laqiya 'Umran
ERDI
Dongola
Merga Oasis
Merowe
Mourdi Depression
Bir Natrun Oasis
EGYPTIAN
ENNEDI
Wadi Hawa
Wadi el Melik
Jebel Tageru
Sirdal
Khartoum
Meidob Hills
Malha Crater
SUDAN
Kutum
Mellit
El Fasher
FR. EQUAT. AFRICA
LIBYA
Miles
50 0 50 100 150 200
Route

It served to pay a passing call at Bir Misaha to verify the water supply there, and to map in some more lines of dunes and the limits of the great sand sheet. Where these dune lines happen to cross stony ground the stones are noticeably more brightly polished than those on the desert surface on either side of the dunes out of the course of the sand-charged wind. There is some very rough country to the north-west of Selima, and when approaching the oasis from this angle it is best to skirt round it and enter from the south-west.

At Selima was a supply of petrol, sent out by camel from Wadi Halfa on the Nile. From here a run of 150 miles on the same bearing across the southern edge of the sand-sheet brought us to long. 27°, where we turned south-west to strike Grassy Valley, which needs a word of explanation. In November 1930 six of us under the leadership of Major Bagnold were crossing the desert from 'Uweinat to Selima. About 100 miles south-east of 'Uweinat we entered an area of scattered hills and flat-topped, sandstone ridges amongst which lay a broad sandy valley, and in the bottom of it a little green grass. In those days one was ever on the look-out for the legendary Zerzura, and this seemed as hopeful a locality as any. We should have liked to stop and explore it more carefully, but time was short and, owing to the breakdown of one of our three cars a few days before, six men and all their supplies were packed into two cars which we did not wish to subject to any unnecessary strain. Though the grass was most probably due to surface rainfall we seemed to have been descending as we came eastwards, and there was always a chance of artesian water in the vicinity. An omission, by the writer, to take aneroid readings for altitude left things still more in doubt. A chance to re-examine Grassy Valley thus came in 1935. We reached it on February 5; the grass of 1930 was now dry and withered. Cars radiated out in all directions, but their surveys and the aneroid readings soon showed that there were some hundreds of feet between the ground-level and the static water contour. As a site for Zerzura Grassy Valley must be discarded. However our visit was not without profit for we found and excavated a solitary grave cairn which contained a skeleton buried in crouched position. Around its neck was a string of carnelian beads and by its side one pot. Both beads and pot are closely paralleled in the Egyptian Predynastic period. There is plenty of evidence hereabouts of surface drainage in the past; some high, flat-topped hills 15 or 20 miles away to the north-west might be worth exploring.

From Grassy Valley we continued south-westwards. By going on as far as long. 25° 15′ and then turning due south down that meridian we should be passing through the centre of a tract of unexplored country between the routes of Kemal el Din and Bagnold. At our turning point in lat. 20° 40′ Jebel Kissu near 'Uweinat was visible 70 miles away to the north-west. Turning south from here we were soon skirting a scarp which lay to the east of our route, later it bent westwards and we ascended it to a low, broken plateau. On this the going was very rough but should be better a few miles to the west. When we had worked south as far as lat. 19° 20′, where Kemal el Din's Erdi-Merga route cut ours, we were on an open sand plain again. There were a number of querns and grinding stones along the route. Farther south again, in lat. 18° 30′, the desert was fairly flat, the surface sandy with

many exposures of grey mud.[1] On one of these we found freshwater shells, sherds, and preserved in the mud the round hole in which the stem of a tree, probably an acacia, had stood. We crossed a few lines of dunes here composed of *barchans* and of sand mounds without the typical crescentic shape. The axis of the lines was about 50°, confirming the fact that as one goes south the dune lines, which north of lat. 23° run almost due north and south, turn away south-westwards. We camped in one of these *barchans* on February 7, and while taking a set of sand samples I found the sand 15 inches down to be moist enough to "ball" in the hand. At a similar depth on the desert away from the dune it was absolutely dry. The moisture must be due to rainfall and the loose surface sand of the dune reduces evaporation to a minimum.

At lat. 18° the dry stubs of past years' *gizu* began to appear, and hereabouts we saw the first addax. In 1932 the country well north of the Wadi Hawa had been swarming with addax, oryx, gazelle, and ostrich, but this year, owing to the failure of the *gizu*, there were very few indeed.

It was near here on the north side of the Wadi Hawa that Strutt met with the accident which ended so tragically. In a fall from the running-board of a slowly moving car he broke two ribs which pierced his lung. We were then nearly 300 miles from El Fasher, the nearest point at which we could hope to find medical aid. We started for El Fasher on the second morning after the accident, and on the evening of the following day were in Kutum, the headquarters of the Northern Darfur District. McEuen and I went on to El Fasher that night, and on the following morning Captain G. L. Prendergast, a member of many Bagnold expeditions and now attached to the Western Arab Corps, flew out to Kutum in his private aeroplane and brought Strutt back. A dust-storm was blowing and the flight was a fine piece of work in conditions of very low visibility. Strutt remained in hospital in El Fasher for three weeks; at first his condition improved, but later complications arose, and on March 6 he was moved by R.A.F. plane to Khartoum where, after some further improvement, he died on March 25. Nothing could have exceeded the kindness of the Sudan officials in El Fasher, both to Strutt in hospital and to ourselves, and we owe an especial debt of gratitude to Colonel G. K. Maurice, of the Sudan Medical Department, and to Mr. A. J. Arkell.

After some days in El Fasher and with a more hopeful report of Strutt's condition Mason, McEuen, Harding Newman, and I returned *via* Musbat to the Wadi Hawa; Mrs. Strutt remaining in El Fasher. The exploration of the Wadi Hawa in all its aspects was one of the main objects of the expedition.

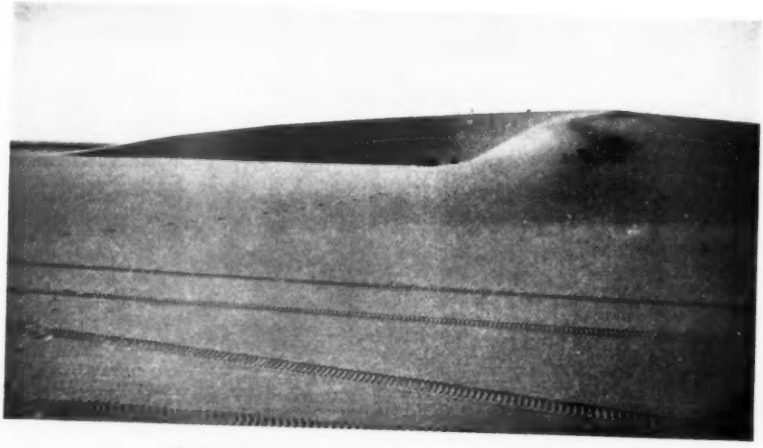
The Wadi Hawa

The Wadi Hawa is the most interesting natural feature of the southern Libyan Desert. It rises—if a normally dry river can be said to rise—in lat. 14° 46′, long. 22° 36′, about 8 miles south-west of Lake Undur. From here as far as Bahai, lat. 15° 29′, long. 22° 55′, it is known as the Wadi Tini; near Bahai it is joined from the west by the Wadi Greigui, and the two form the Wadi Hawa. From its source to the point at which it fades out in the desert south-south-east of Bir Natrun it has a length of about 395 miles (the Thames

[1] See remarks by Sandford on p. 213.

Wind-eroded mud deposits E. of the Gilf Kebir

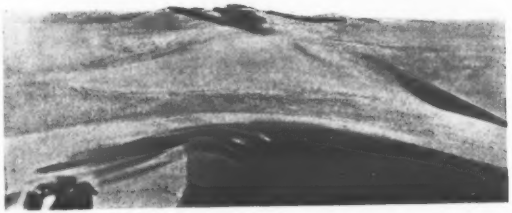
One of the expedition's cars



Camp in "barchan" dune S.W. of Dakhla

The Wadi Hawa in Long. 24° 30'

The Wadi Hawa in Long. 26° 45'



A dune line in the Sand-Sea

Extricating car from soft sand

is 209 miles long) and through this distance falls from 3115 to 1650 feet. Lake Undur is now dry from March until the rains in July–August, though it is interesting to note that Grossard[1] states that until 1913 the lake was permanent. These wadis run at intervals during the rains and temporary pools are formed in the lower reaches of the Wadi Hawa, but it is unlikely that water ever runs on the surface east of long. 24° 15′. The last permanent well is at Bahai, 70 miles from the source; water is found in *tumuds* at Bir Buweira, 60 miles farther downstream, for four months after the rains and also at Sindia in a northern tributary of the Wadi Hawa in long. 24° 8′. Upstream of Bahai the wadi is confined within fairly narrow banks, but below this point it gradually opens out to become a wide belt of vegetation contained in a shallow valley which may be anything up to 5 miles across. I have not seen anything of the wadi west of long. 24°, and these details are taken from Grossard's book and Sandford's paper.[2]

West of the international frontier the wadi has the sparsely populated hills of Ennedi to the north of it and the scattered villages of Dar Zaghawa to the south, but east of long. 24° it stretches across the desert in splendid isolation, uninhabited and confined by absolute desert on the north and by desert or the poorest savannah on the south. Natives of N. Darfur use it as a convenient route to the saltpans of Bir Natrun, and we met a party of Zaghawa hunting addax, but otherwise it is little visited.

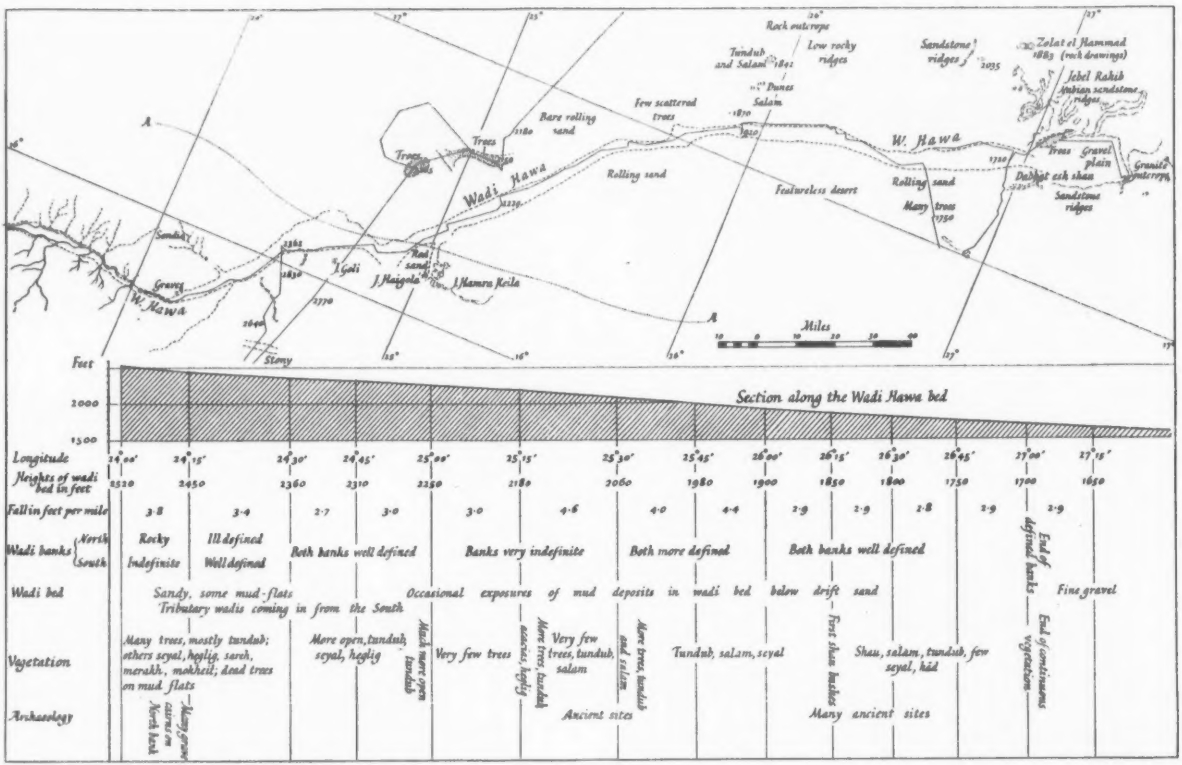
Name

Hawa is the Arabic for wind, and one naturally assumes that Wadi Hawa means Valley of the Winds, a not unsuitable name. But Mr. A. J. Arkell, the Deputy Governor of Darfur Province, tells me that Hawa (or rather Hawar) *may* be derived from two Zaghawa words *Urei* and *Ow*, meaning respectively "wadi" and "sheepskin" (*farwa* in Arabic), the implication being that the wadi unrolls itself across the desert as one would unroll and lay out a sheepskin, universally used in the Sudan on top of a camel saddle, before sitting down on it. The Zaghawa now occupy the country towards the west end of the wadi, and their tradition is that they once extended farther east. In this paper I have retained the spelling Hawa previously used in this *Journal* and on some other maps. On the Sudan sheets it is usually written Howar.

Survey

West of long. 24° the wadi forms the boundary between French Equatorial Africa and the Anglo-Egyptian Sudan, and was surveyed by the boundary commission of 1921–22. East of this meridian it was until recently little known. Newbold in 1923, Newbold and I in 1927, Bagnold's party and Sandison with the S.D.F. patrol in 1932, and Almasy in 1933, had crossed it at various points or followed its bed for some distance. At the beginning of 1935 there was a section of some 50 miles east of long. 25° quite unsurveyed and the extreme east end of the wadi, south of Jebel Rahib, was unknown. Our expedition traversed the whole length of the wadi from long. 24° eastwards, but a week or so before us Almasy had followed it from Jebel Rahib as far as

[1] *Mission de Délimitation de L'Afrique Equatoriale Française*, Paris 1925.
[2] *Geogr. J.*, vol. 85, p. 412.


Rock outcrops
Tundub and Salam
Low rocky ridges
Sandstone ridges
Zolat el Hammad 1883 (rock drawings)
Jebel Rahib (nubian sandstone ridges)
Few scattered trees
Bare rolling sand
Trees
Wadi Hawa
Rolling sand
Featureless desert
W. Hawa
Gravel plain
Granite outcrops
Dabbat esh shau
Sandstone ridges
Many trees
Trees
Gravel
Sandhills
Red sand
J. Goli
J. Haigala
J. Hamra Keila
Stony
Miles
Section along the Wadi Hawa bed
Feet
Longitude
Heights of wadi bed in feet
Fall in feet per mile
Wadi banks
Wadi bed
Vegetation
Archaeology
Rocky
Ill defined
Both banks well defined
Banks very indefinite
Both more defined
Both banks well defined
Indefinite
Well defined
Sandy, some mud-flats
Occasional exposures of mud deposits in wadi bed below drift sand
Fine gravel
Tributary wadis coming in from the South
Many trees, mostly tundub; others seyal, heglig, sarh, merakh, mukheil; dead trees on mud flats
More open, tundub, seyal, heglig
Much more open tundub
Very few trees
More trees, tundub, acacias, heglig
Very few trees, tundub, salam
More trees, tundub and talam
Tundub, salam, seyal
First shau bushes
Shau, salam, tundub, few seyal, hid
End of defined banks
End of continuous vegetation
North kosh
Many graves
Ancient sites
Many ancient sites

long. 25° 15′ before turning south to Anka Wells. The course of the wadi is now therefore fairly accurately surveyed. From the frontier it is easy enough to trace as far east as long. 25° 20′. Thereafter for some distance the banks are most indefinite and there are very few trees to mark the bed. Later the vegetation becomes denser and continues so to about long. 27°, where it finally dies out. East of that point the course is almost impossible to trace, but it seems probable that one small branch of the wadi takes off on the north side to run to a dead end in a treed depression at the south-west foot of Jebel Rahib. Here are exposures of granitic rocks. The main wadi continues east to a wide level plain of fine gravel and sand bounded on the north by Jebel Rahib and on the south and east by sandstone ridges, and on which are a few isolated patches of vegetation. From this plain there is no apparent outlet except at the south-east corner. Here at the lowest point a gap between the ridges, some 2 miles wide, is now filled with dunes 50 feet or more high, but might once have been a possible outlet for the wadi. Had it originally passed through this gap it may have continued east over what is now a plain of fine gravel or rolling sand for another 20 miles or so. Beyond that low hills and ridges seem to bar the way, and it is unlikely that the wadi at its present level ever went on to join the Nile. That—as Frobenius would have us suppose[1]—as late as Upper Palaeolithic times the Wadi Hawa, passing to the east of Bir Natrun and being joined at Laqiya by the Wadi el Qa'ab, which had in its turn absorbed the Wadi el Melik, and later picking up tributaries from Burg et Tuyur, Selima, and Terfawi, swept on to Kharga, up the 1000-foot scarp north of the oasis, and so through Bahariya Oasis to the sea is fantastic.

An interesting point remains to be cleared up. With Bagnold in 1932 we came upon an unexpected belt of trees some 20 miles north of the wadi in long. 24° 50′. In 1935 we traced this belt, if rather intermittently, for a further 25 miles to the north-east. Since our expedition I have discussed the question with Almasy, who considers that these belts of trees may indicate a tributary wadi running parallel to the Wadi Hawa and finally joining it about long. 25° 25′.

Geology

Sandford has described the geology and water supply of the Wadi Hawa in his paper.[2] The observations made during our expedition have been used by him in a paper in the *Quart. Jour. Geol. Soc.*, vol. xci, p. 323, and are discussed in an appendix to this article.

Levels

East of the frontier all levels are from aneroid readings, and naturally enough there is a good deal of discrepancy between the values obtained. For the profile which accompanies this paper I have plotted the heights observed at various stations along the course and drawn a smooth curve through the points. Within its obvious limitations and until accurate levels are obtained this should give a fairly reliable result. From 4 feet per mile near the frontier the gradient falls to 3 feet in long. 25°. Then for 50 miles or so it is steeper at

[1] Mitteilungen des Forschungs- Instituts für Kulturmorphologie. Frankfurt A. M. Bilderbuchblatt, 4, 1934.

[2] *Geogr. J.*, vol. 85.

4½ feet per mile, later flattening out to 3 feet per mile for the last 80 miles of its course. (The gradients given in Sandford's paper, on p. 419, differ somewhat from mine owing to a discrepancy between Bagnold's figure and mine for a common camp site near long. 24° 30′.)

Animals

One of the chief attractions of the Wadi Hawa lies in the abundance of animal life. Around long. 24° 30′, where this year the game was most plentiful, we found oryx, addax, ril, gazelle, three giraffe, ostrich, hyaena, jackal, fox, monkeys, the shy antbear, porcupine, and countless bustard. The addax normally range north of the oryx; this year we found them both in the wadi and the oryx as far south as lat. 15° 30′. Maydon's party had shot a lion in the Wadi Hawa in 1934, and though we saw none we found two large "earths" beneath a *tundub* tree evidently recently in active occupation, for all around lay the bones and horns from the lion's kills. Grossard notes that three lions were shot by the Boundary Commission in Ennedi. One day Mason came on a pack of fourteen hunting dogs (*Lycaon pictus*), which kill a lot of game. Farther east, as the vegetation thins, the game is naturally less, but we saw seven addax in long. 27° 45′. As has been stated above, in years of good rain an occasional pool may form in the upper reaches of the wadi, but for all practical purposes it is waterless east of the frontier and one is forced to the conclusion that all these animals can live entirely without drinking. The moisture they need must be obtained from the withered-looking grasses, yet the contents of a freshly killed gazelle's stomach show clearly that they find all the liquid they require.

Vegetation

(For the sake of brevity I have used the native names of plants; a list of their botanical equivalents will be found below.)

Were it not for the wide ribbon of vegetation one might cross the wadi without noticing it save where the banks are high and well defined. Near long. 24°, and in fact throughout most of the lower half of the wadi, *tundub* is the predominant tree. Other species here are *seyal*, *heglig*, *sareh*, *merakh*, and *mokheit*. Underfoot is a growth of grasses which depends more directly on the rainfall of the year. Going east the vegetation thins until in long. 25° 20′ there is nothing but a few isolated *tundubs*, about two per mile, to mark the bed. Thereafter, in long. 25° 40′, the vegetation thickens again, *salam* on sand mounds and some larger *seyal* replacing the *tundub*.

In long. 26° 10′ *shau*, a straggling bush growing on sand mounds, makes a noticeably sudden appearance, and from there on is the commonest plant, though there is also much *had*. East of long. 26° the *seyal*, though fewer in number, are much larger, some trees being 40 feet high and 2 feet in diameter. *Shau* and *had*, with *salam* and a decreasing number of *seyal*, continue to long. 27° 05′, at about which point the vegetation finally ceases.

I have said that no water flows along the surface east of long. 24° 15′. From where then does the vegetation get its water? Sandford [1] concludes that the eastward percolation of water below the surface supplies the answer. A

[1] *Geogr. J.*, vol. 85, p. 422.

similar movement of water underground is described by Gautier [1] in the case of the Wadi Saoura in the Algerian Sahara, and this wadi is in many other ways comparable to the Wadi Hawa.

Botanical names of plants

Heglig	Balanites aegyptiaca. Del.
Tundub	Capparis decidua. Pax.
Merakh	Leptadenia Spartium. Wight.
Seyal	Acacia spirocarpa. Hochst.
Salam	Acacia flava. Schweinf.
Shau	Salvadora persica. L.
Had	Cornulaca monacantha. Del.
Sareh	Maerua crassifolia. Forssk.
Mokheit	Boscia octandra. Hochst.

The "tussocks" so often referred to are mostly of *Panicum turgidum Forssk.*

Wadi bed

Near the frontier, west of long. 24° 30′, the bed of the wadi is either buff sand or wide, level flats of mud. On the latter the trees are dead or dying, killed, as Sandford points out, not by drought but by excess of water. These flats cease about long. 24° 30′, and as one goes east the drift-sand increases, being exceptionally thick about long. 25° 15′. But here, and in fact along the whole length of the wadi, one may see occasional exposures of mud between the sand drifts. The mud is grey or black and very hard; I have dug into it no deeper than 2 feet but did not come to the bottom of it.

A short line of *barchan* dunes in long. 28° 15′, and the direction of the sand-drifts farther east, indicate that the prevailing wind is from the north-east. It appears that the general tendency here is for the sand to blow upstream of the wadi.

Archaeology

Here I do not intend to do more than mention very briefly the occurrence of ancient sites along the wadi: a full discussion of them is outside the scope of this paper. On a hill on the north bank in long. 24° 10′ are some hundreds of stone grave cairns. We opened two of these and in each found a single contracted burial, with no objects in the grave. Eastwards from here are few ancient sites, but at long. 25° 15′ they appear again and from long. 26° to 27° are frequent on both banks and sometimes in the bed. At a large site the ground is covered with sherds, ashes, and burnt bones, and one finds many polished diorite axes, ostrich-shell beads, querns, grinders, etc. We excavated two or three skeletons; round the neck of one was a string of five turquoise beads which have been dated tentatively to the Egyptian Old Kingdom period, and at its waist many coils of ostrich-shell beads. Finding graves here is very largely a matter of luck. There are no cairns, presumably for lack of stone, and the burials have been made in the sand with nothing to mark them. According to the depth at which the bodies were originally placed and the rate at which erosion of the surface has been going on locally the skeletons are

[1] *Le Sahara*, Paris 1928, ch. 3.

either scattered abroad, just appearing on the surface or invisible below it. Digging below the surface usually reveals sterile sand. Farther east near Jebel Rahib are more cairns; in one of these the two halves of an ox's jaw had been buried alongside the skeleton. In the desert a mile or so north of the bank no sites were found, but south of the wadi, particularly on the west side of Jebel Tageru, they were frequent.

No doubt these Wadi Hawa sites will one day be carefully and systematically examined; on a small expedition without native labour it is difficult to do more than reconnoitre. The organization of an expedition on a larger scale would be difficult and expensive, but I consider the best results would be obtained by making a base on the wadi in about long. 26° 30′, obtaining supplies by one or two large camel convoys from El Fasher and water by car from Bir Natrun.

We had left El Fasher on February 17 and on the 25th, having followed the wadi as far as long. 26° 35′, turned off south-east towards Jebel Tageru. This, first discovered by Newbold in 1923, is a flat-topped, fairly continuous, sandstone plateau rising some 200 feet above the plain and stretching for 80 miles from north to south; at its widest point it is 15–20 miles from east to west. In Jebel Tageru there are a number of rock-wells which hold water for varying periods after the rains; we visited three of these but found no water. At the southernmost, Qelti el Musawwar, were a few Kababish Arabs with camels, sheep, and goats. There had been water here earlier in the year, but now they were getting their water from Abu Sufyan, three days' journey away. The rock-well is at the head of a fine gorge which runs back into the hill for about 3 miles. A sill of rock crosses the gorge and below it is a small basin where the water collects. Here on the cliffs, often in places now almost inaccessible, are some dozens of rock drawings, first discovered by Newbold in 1923.[1] They show elephant, giraffe, cattle, and humans, and are mostly scored out in low relief. The results of our survey work seem to show that the whole of Jebel Tageru should be moved 3–5 miles farther west.

From Tageru we made a detour through very rough "tussock" country to Abu Sufyan. There are here a number of interesting remains in red brick, of which the largest is a mound 150 feet in diameter and 20 feet high, roughly circular in shape and built in stepped courses of red brick. It is most probably a tomb, but thorough excavation, which would be a long job, is needed to confirm this and to determine its date. There are some other red-brick ruins in Kordofan and Darfur tentatively dated to the fifteenth to sixteenth centuries, and those at Abu Sufyan may be contemporary.

From Abu Sufyan we turned west over very difficult country to Malha in Meidob and thence to El Fasher. By March 12 we were back again at Malha on the return journey to Egypt. Here we were able to do some useful survey by following the previously unexplored Wadi Magrur. This wadi collects the drainage from the north-west side of the Meidob hills and, running for 60 miles in a north-east direction, finally ends in the Baheir Tageru ("the little sea of Tageru") as the Arabs call the shallow depression which lies at the foot of the Tageru scarp. At its southern end the wadi for some distance skirts the edge of the lava flow from Meidob, and as a result its south bank is almost unsurmountable. The Wadi Magrur may be of some strategic importance in that

[1] *Sudan Notes and Records*, vol. vii, No. 1.

the smoother going in its bed provides a sort of corridor from north to south through the "tussock" area south of lat. 16° 30′ where the going is so very bad for cars. We had been travelling through this type of country for some days going to and returning from Abu Sufyan and were well able to appreciate its difficulties. Hard based tussocks of long grass and small dry rain runnels compel one to bump over them for hours on end in low or second gear, with consequent damage to the cars.

The course of the wadi is clearly marked by its vegetation; acacias predominate with some *heglig*, *sareh*, and *tundub*. Near lat. 15° 45′ it cuts three gorges through the Nubian Sandstone which, though just passable to cars, it is better to avoid. In them is exposed an interesting geological section, to which Sandford refers on p. 212.

From the north end of the Wadi Magrur we made straight for the Wadi Hawa to complete our survey. Having done our best with the east end of the wadi we circled round Jebel Rahib and on its south-east side found ourselves unexpectedly in an area of granitic rocks. These later ran under the Nubian Sandstone but appeared again south-east of Merga. Here, in lat. 18° 52′, long. 27° 11′, where the granite is exposed at the foot of a Nubian Sandstone scarp was a tiny "false oasis"—a little patch of acacias, *tundubs*, and dried grass owing its existence to an occasional rainstorm and not to artesian water. The place is only some 10 miles west of the Darb el Arba'in and was presumably known to travellers along that caravan route, for there was camel dung and the ashes of old fires among the trees. A quail and a mountain sheep were the only inhabitants; in the latter we have an example of how far these desert animals will travel from one patch of wretched grazing to another, for as far as is known the nearest vegetation is at Merga, 70 miles away. The granite continues to within 25 miles of Merga.

A bad sandstorm was blowing on the afternoon of March 19 and a few drops of rain fell during the night. We were fortunate in finding a *barchan* in the lee of which to camp. In the desert where every natural feature is streamlined by the sand-charged wind these crescentic dunes afford excellent sheltered camping-places.

Near Merga we were anxious to visit and verify the position of a well located in 1932 by Almasy, which must certainly be Bir Bidi.[1] This is a water-hole on the north side of Wadi Hussein, the water-bearing depression discovered by Newbold and myself in 1927. The well is 3 ft. deep, lying near two dwarf palms at the north end of a sandstone ridge. Nearby are the remains of some Goraan huts. We made its position lat. 19° 02′ 15″, long. 26° 27′ 45″, and the water 1780 feet above sea-level, though this figure is from one set of readings only.

There had been various reports of a small oasis or well some 40 miles north of Wadi Hussein. Almasy had heard native rumours of it and Newbold, in a flight north of Merga in 1931, had seen what appeared to be a patch of green vegetation. We had made a short search for this place with Bagnold in 1932 and a more careful one this year brought us to the same conclusion, that on this incredibly stony plateau, 450 feet above the static water-level, no well or oasis exists.

[1] *Geogr. J.*, vol. 72, p. 547.

A day's run brought us to the interesting depression (Camp 49) lying between Merga and Burg et Tuyur. Newbold and I had passed 15 west of this in 1927; it had been partly examined by Almasy in 1933 and later by Prendergast in 1934. The depression has three arms which from their junction radiate out north-east, south, and south-west for some 10, 6, and 15 miles respectively. The bottom is sandy, rising to low cliffs. In the south-west, where it is deepest, it is 250 feet below the general desert plateau but still 350 feet or so above the probable static water contour. There is no vegetation save for a couple of moribund *tundubs*. There were a number of old mud-pans in the bottom, and no doubt the water collecting there had made the place attractive to the early inhabitants of the desert. Prendergast had collected some pottery and implements and we found more of these and a skeleton just beginning to emerge from the sand, lying on its right side in a contracted position of burial.

The skull is of especial interest. Dr. Cave, the Assistant Conservator at the Royal College of Surgeons Museum, who has kindly examined it for me, reports: "In its form, contours and various proportions this skull agrees so strikingly with the Predynastic cranium that it may be referred to this type without hesitation." There were no objects in the grave, in fact there was no grave in the strict sense of the word, but scattered in the immediate vicinity were animal bones, sherds, polished stone axes, ostrich shell fragments, and other objects of a type similar to those found on the Wadi Hawa. The association between the skeleton and the other remains is not of course proved, but at least it may be conjectured that they are contemporary. Hitherto a Meroitic date has usually been assigned to the material from the Wadi Hawa sites, and there are certainly similarities between the incised pottery found at the two places. Now a number of facts combine to suggest that these remains are really much earlier. The burial at Camp 49, that in Grassy Valley 80 miles to the north-west, the beads from the one mentioned on p. 197, and the fact that we found three or four more contracted burials along the Wadi Hawa, though unfortunately none had objects buried with them, are all significant. Another point is that the only polished stone axes found in Egypt at all similar to the very characteristic ones from the Wadi Hawa[1] come from the lowest levels at Koptos and are of Predynastic or Old Kingdom date.

In order to support settlements of a size indicated by these sites the climate must have been wetter than to-day. The numerous querns and grinding stones are a proof of agriculture, the diorite "axes" may well have been agricultural implements and the bones of a large *Bos* (species unidentified) are among those collected. It would not now be possible to grow crops or pasture cattle along the Wadi Hawa. There is little evidence of such an improvement in climate in Meroitic times but more reason to suppose a greater rainfall four thousand or five thousand years earlier. To sum up, there appears to have been living along the wadi, and in the neighbouring oases, a considerable population, practising agriculture, pasturing cattle, making good pottery with very varied incised designs, using ostrich-shell beads and occasionally beads of turquoise (? imported from Sinai) and burying their dead in a contracted position. We found no metal on the sites, but were hardly in a position to search effectively. Whether these people drew the rock pictures we do not

[1] Petrie, *Prehistoric Egypt*, p. 24.

know; we may note that those on Sphinx Hill in Wadi Hussein north of Merga are very similar to some of Old Kingdom or earlier date as Aswan.[1]

Ball,[2] discussing the formation of the oasis depressions of the Libyan Desert, shows that given certain preliminary conditions wind erosion is the chief agency in their excavation. We have here perhaps an oasis in the course of formation, and this Predynastic burial, situated 20 feet or so above the bottom of the depression and more than 200 feet below the top, gives an idea of the rate at which erosion proceeds; in the last six thousand years the deepening has been almost negligible.

We took a new route to Selima between the Darb el Arba'in and our 1927 and 1932 tracks, passing on the way three or four irregular stone circles. At Selima we picked up 120 gallons of petrol per car and also oil and water. At this point perhaps the simplest thing would have been to go straight to Kharga and thence to Cairo, but we were reluctant to follow a route now so well known and determined to try to reach Siwa up the west side of the Gilf and through the Sand Sea. From the Selima to the north-west corner of the Gilf calls for little comment. As far as 'Uweinat the way is marked by the countless tracks of the Sudan Defence Force cars made when the Sudan Government had a post there in 1934. In the sand, even when the tracks are invisible, one can still feel on crossing them the drag on the steering where one's wheels sink into the old ruts. 'Uweinat is usually visible 50 miles away, but a sandstorm was blowing as we approached it in the afternoon so that it was never in sight; we camped with no very precise idea of our position and awoke the next morning to find ourselves about 5 miles from the 6000-foot mountain. Up the side of the Gilf we were following the routes of previous parties. I know of few finer sights than the western scarp of the Gilf Kebir. From out on the plain to the west one looks back at a cliff, 1000 feet high, stretching north and south for 70 miles without apparent break, save where a sandy slope leads up to the entrance to the Gap.

April 1 was appropriately remarkable for the worst sandstorm we encountered. It blew for hours on a south-west wind with gusts up to 60 m.p.h. Yet in spite of the fact that horizontal visibility was reduced to about 200 yards we were able to use the sun-compass almost the whole time. A dust-storm, often miscalled a sandstorm, may be 1000 feet in vertical thickness, almost turning day into night. But a storm of true desert sand, and this was the worst I personally had ever been in, yet allows the sun's light to cast a shadow on the compass dial because the blowing sand does not rise more than 30 feet or so above the ground.

We entered the Sand Sea in lat. 25° by the Wadi el Gubba up which runs the Kufara–Egypt caravan route which crosses the dunes and leads on to Abu Mungar. This route was in use when the Turks occupied the oases of Cyrenaica and again during the Italian reconquest after the Great War. Now that the Italians hold Kufara it is unlikely that it will be used much again. Of all the desert roads of Africa this was probably the most exacting for men and animals, with twelve days between water, no grazing on the way, and the towering dune-ranges to cross.

[1] Frobenius and Breuil, *L'Afrique*, p. 61.
[2] *Geogr. J.*, vol. 70, p. 32.

The first sight of the Sand Sea from this angle was fascinating if slightly alarming. From a stony plateau to the west one sees first of all a pale buff blur on the horizon, later this changes to line upon line of parallel crested dunes (*seifs*) a mile or two apart, up to 30–40 miles along, and some of them 250 feet high. The beauty of these dunes is astounding; at midday they may be flat and uninteresting, but in the morning or late evening the shadows show up the symmetry of their sweeping curves. This great dry sea of sand is as changing as the ocean. On a cool day when things are going well, "sticks" few, and one is sure of one's position, there can be, to the desert lover, no more entrancing place. But when a hot wind is blowing and the cars are sticking in "liquid" sand every few yards one begins to remember that the nearest water is probably more than 100 miles away and to realize that there can be few more unpleasant places in which to be lost. I retain two impressions of the Sand Sea—one of extraordinary cleanness, for here is no animal life, no plants, no earth even to change the sterile yellow sand. And the second of an overwhelming if rather static power—it is as though you were in the trough between two towering waves, frozen still for the moment but able if they chose, to resume their movement and overwhelm you. One wonders if this huge waste, in area about that of Ireland, will ever be put to some useful if prosaic purpose.

It was in long. 25° 30′ at the south end of the Sand Sea that Clayton found the now famous silica glass,[1] which occurs in the "streets" between the dune lines where the sandstone is exposed. In the streets the going is secure, but once in a street there can be no question of getting into an adjoining one until there is a break in the dune-line on one side. Imagine yourself moving between two ridges 200 feet or more high, composed of nothing but dry yellow sand grains, and stretching almost unbroken from London to, say, Reading.

Sixty miles north of the end of the sands the stony streets come to an end and the whole country is submerged in sand. Thus far we had had good hard going at the foot of the dune ranges, but now our difficulties might begin. Four men form really too small a party to take cars through the Sand Sea. In the patches of "liquid" sand in which any car will stick one is largely dependent on man power to get out again. One man must drive, so with a party of four only three are left to push. We had the usual "unsticking" gear—steel channels and rope ladders[2]—and on the whole experienced little trouble, far less than I had feared. This was very largely due to the use of Dunlop air-wheels; provided one can keep up speed the car will rush through soft patches in which smaller tyres would certainly stick.

Our objective was Siwa, and from Siwa the dunes run slightly east of south on a bearing of about 170°–350°. It is obviously easier to go up the corridors between the dunes and de Lancey Forth had found the dunes south of Siwa very high.[3] We therefore wished to make some easting early and then go north-north-west up the dune lines to Siwa. The best place to do this would be in about lat. 27° where Clayton, the only person to cross the Sand Sea by car directly from east to west, had found a route. After the "street" country

[1] L. J. Spencer and P. A. Clayton in *Mineralogical Magazine*, vol. 23, p. 501.
[2] *Geogr. J.*, vol. 78, p. 29.
[3] *Geogr. J.*, vol. 75, p. 49.

is left behind the lines of uncrossable crests become gradually shorter and by lat. 26° 45′ it is possible to work through from west to east. Though the *seifs* are fewer the sand retains its general north–south structure with rolling "downs" sloping gradually upwards from the west to a steep eastern slope. This slope may be hard or soft, if the latter the cars had to be driven to the edge and then slid down 100 feet or more of soft sand to the bottom. Once over the crest the car was up to its axles in sand and must be kept going to avoid turning over sideways. Sometimes the disturbance of this huge area of loose grains would start them "singing" with a dull grunting note. But on one precipice of soft sand the cars driven by Mason and McEuen were descending side by side and the booming of the sand was so loud that they could hardly hear one another shout at 5 yards' range. At the foot of the eastern slope the ground was often hard, occasionally the underlying desert floor being exposed. Gaining speed here one must rush up the westward slope, and it was in soft patches here that we sometimes stuck.

Finally, having made our easting we turned north for Siwa in lat. 26° 30′, long. 27° 10′. Later the *seifs* began again, but we found fair going high up near the west side of the crest. With occasional exceptions the following rules hold good in the Sand Sea. In uncrested dunes keep always to the summits; yellow ribbed sand is nearly always hard; smooth, shining purple-grey surfaces are usually "liquid"; "giant ripples," more than 12 inches from crest to crest, are often soft. By lat. 28° 40′ we were getting into limestone country, a plateau eroded into many shallow basins half filled with sand which were easier to get into than out of. This continued to within 10 miles of the Siwa depression which in turn is guarded on the south by a belt of confused dunes not easy to cross. At dusk on April 5 we were in Siwa, hospitably received by the officials of the Frontier Districts Administration. From here three days' easy going by way of Mersa Matruh, Burg el Arab, and the Wadi Natrun brought us to Cairo on April 9. Since January 14 we had travelled about 6300 miles, of which half had been through unexplored country.

The performance of the Ford cars was most satisfactory. They were usually overloaded; on occasion we were carrying 2300 lb. and the makers' specification is 1700 on normal roads. The major breakages, which we quite expected, were four main leaves in the front springs and five rear spring shackles. To replace the latter a spring-spreader is needed. This is not an easy tool to obtain; we had one made in Cairo, but it soon bent and became useless, but by the ingenious use of many jacks Harding Newman dispensed with it. On this model the battery is placed too low for very rough country; the actual clearance is sufficient but it is situated half-way between the front and rear axles and gets damaged when the car is straddling an obstacle. Our petrol consumption was a shade over 13 m.p.g. That this is rather lower than on previous expeditions may be due to the use of airwheels, but their enormous compensating advantages easily outweigh this fact.

In a paper on "The Encroaching Sahara" published in the *Journal* for June 1935[1] Professor Stebbing has drawn attention to the danger of the advancing desert in the West African colonies of Great Britain and France. I have had the opportunity of discussing this question with Professor Stebbing in the

[1] *Geogr. J.*, vol. 85, p. 506.

light of conditions in the Anglo-Egyptian Sudan. During our expedition last year the pressure of other work prevented us from giving to this problem as much time as it probably deserved, but even so certain observations are worth putting on record. I should point out that the question is one of the present-day increase of desert conditions due entirely or largely to the action of man; climatic desiccation since historical times is only indirectly concerned.

On the maps I have marked three zones:

NORTH

Zone 1. Absolute desert, except for occasional patches of *gizu*. (*Gizu*—An Arabic word applied to the ephemeral vegetation of low grasses and herbs which springs up on the southern edge of the desert following occasional and very localized rainstorms. For fuller details see *Kew Bulletin*, No. 7, 1934, p. 282.)

Line A .....

Zone 2. Very scattered trees (*heglig*, *tundub*, *sareh*, *acacias*), grass tussocks; no cultivation; no settled population; in the north little or no available water; grazing by nomads. In the north of this zone conditions have got beyond the savannah stage—as Professor Stebbing uses the word; in the south there is savannah.

Line B .....

Zone 3. Savannah in the north, improving southwards to dry mixed deciduous forest; settled population; cultivation; wells.

As far as I am able to judge the danger from the advancing desert is less in the Sudan than in West Africa for the following reasons:

1. West Africa is flat and low-lying; all the area in question is under 500 metres above sea-level, whereas all Northern Darfur is above this. In Darfur the large hill-features of Tageru, Teiga, Meidob, and Tagabo present a natural barrier to the advance of the sand and at the same time tend locally to increase the rainfall.
2. The Wadi Hawa also forms a barrier to the sand.[1]
3. The population is much less in the Sudan, 5 per square mile in Darfur as against 40 per square mile in N. Nigeria, with consequently less destruction of existing forests.
4. In Nigeria[2] water seems to be available, and therefore habitation or grazing by nomads possible, very much nearer to the actual line now reached by the Sahara. In Darfur there is a wider No Man's Land—my Zone 2.
5. The great lines of dunes which in the northern part of the Libyan Desert run nearly due north and south turn away westwards as they come south, and in latitude 19 are moving south-west.

I hope that what I have written above will not lull the appropriate department of the Sudan Government into any false sense of security. To send a forest officer for a three months' trek, by camel, through N. Darfur and Kordofan to verify or refute my hasty conclusions would cost about £250. The money would be well spent.

[1] See Sandford in *Geogr. J.*, vol. 85, p. 421.
[2] Stebbing, *op. cit.* p. 510.

APPENDIX I: SURVEY

W. B. KENNEDY SHAW

The survey equipment comprised a 5-inch micrometer theodolite by Cary, two Bagnold sun-compasses, prismatic compasses, plane-table, five aneroids, Philips short and medium wave receiving set, two half chronometer watches and a Waltham deck-clock. For the loan of most of these we were indebted to the Society and to Colonel A. H. Bagnold and Major R. A. Bagnold.

The methods of route survey which have proved so effective on previous desert expeditions were used again (*Geogr. J.*, December 1931, p. 529). The run was recorded by the navigator from kilometre readings and sun-compass bearings and the course plotted on the map as opportunity offered during the day and finished at night. At each camp an astronomical position was obtained, using E. and W. stars for L.M.T. and usually Polaris and a S. star for latitude. The position thus determined was used as the starting-point for the next day's run, and on return to England the separate sections of the traverse were adjusted to the astronomically fixed positions.[1] We learnt two points of practical interest about the sun-compass—that an ivorine dial cracks in the Libyan heat and that a wholly white dial (*e.g.* of nickel silver) is preferable to a black one as the former will often show up the sun's shadow on days when cloud or a sandstorm partly obscures its light. McEuen took the W/T signals for time and I did the astronomical observations and the route survey.

Barometric altitudes

In addition to one small pocket aneroid we carried four larger surveying aneroids. These were recorded by Mason at dawn, the lunch halt, and at night, and also at any other points of special interest. The pocket instrument, checked against the others, was used for intermediate heights while on the move. The aneroids were compared for index error in Cairo, on departure and return, at Kharga, Dakhla, and El Fasher (twice). On the whole they behaved well. The estimated m.s.l. pressures corresponding to our observation positions were kindly supplied to me by Mr. Sutton, Director of the Egyptian Meteorological Service, and from them—*tanto labore*—I have computed the corrected altitudes. Of particular interest were the levels along the W. Hawa, which have been discussed elsewhere. The heights of all water-points in the Libyan Desert are important, and we obtained a new value for Selima, the mean of twelve observations with the aneroids, five in February and seven six weeks later. These gave a figure of 890 feet; previous determinations have been 833 (Newbold and Shaw 1927), 807 (Bagnold 1930), and 857 (Bagnold 1932).

APPENDIX II: NOTES ON GEOLOGICAL DATA FROM S. LIBYAN DESERT

K. S. SANDFORD

The available material consists of specimens brought back for identification, notes, and photographs made on the spot. The specimens were well selected in the field and the collection includes no attractive but geologically useless material, as is so often the case; similarly the photographs are of great utility. When the expedition returned a geological report, with the first comprehensive

[1] All the field sheets have been sent to the departments concerned, the Egyptian Desert Surveys or the Sudan Survey Department.

map of the area, was in the press, and I am indebted to the leader for allowing me to include mapping data determined from the results he had achieved, and brief references in the text, the report as a whole thus being brought up to date. The following notes may therefore be referred directly to the report and map, and to the problems involved therein, published in the *Quarterly Journal of the Geological Society*, vol. xci, 1935, pp. 323–381.

1. *Archaean and Pre-Cambrian exposures.*—The expedition added several new outcrops to the map: a large area a little east of a line joining Merga and Bir Natrun, a yet larger area at the lower end of the Wadi Hawa between 27° E. and 28° E., an isolated patch also in the Wadi Hawa due south of Jebel Rahib, and two small patches on the west side of Jebel Tageru.

The eastern limits of the large area at the eastern end of Wadi Hawa were not found, and it is probable that there is a considerable tract of granite, schist, and gneiss here, stretching toward the Nile, analogous to the country between Jebel Tageru and the Wadi el Melik, suggesting the presence of an anticlinal roll which has arched up the ancient floor on which the rocks of the Nubian Series were deposited. On the other hand it is becoming clear that those deposits lie in basins, so that the ridge might be older than the sandstones that have been stripped from it.

The specimens collected from this area are: (1) fine-grained biotite granite-gneiss with included augen of quartzite and quartz; (2) fine-grained, light-coloured biotite granite, possibly gneissic; (3) porphyritic biotite granite with felspar phenocrysts.

The patch in the Wadi Hawa south of Jebel Rahib consists of coarse-grained porphyritic granite with large felspar phenocrysts and much quartz, with quartz reefs running almost due east and west.[1] Dense olivine dolerite was also collected here, but there is no clue to its age: it may well be Tertiary, though such dolerites occur commonly in the ancient complex.

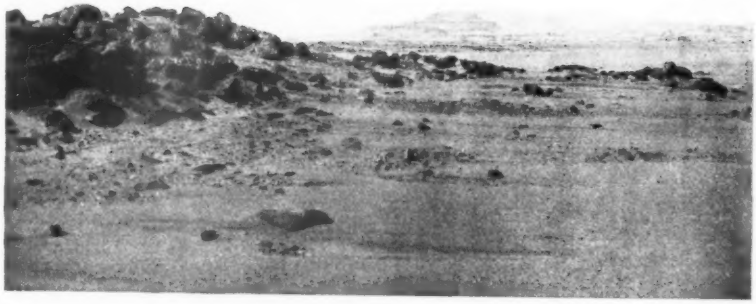
The large area east of Merga consists apparently of biotite granite, some fine grained, some light coloured and porphyritic; in the south-east corner pink granite occurs in a dense, fine-grained schist.

Of the two new small areas on the west side of J. Tageru the southern is of biotite granite and at the northern massive black limestone was collected. These Archaean or Pre-Cambrian limestones occur widely scattered in the Sudan, and are quarried between Abu Hamed and Berber, and elsewhere: one may recall also the marble south of 'Ein Dua, 'Uweinat, found in 1932.

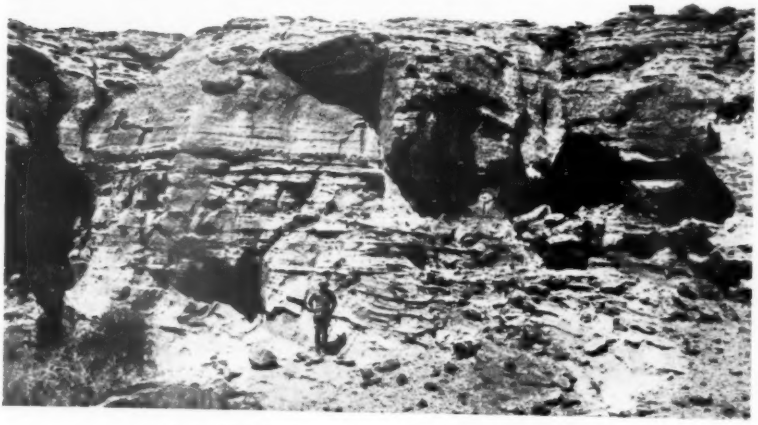
2. *Nubian Series.*—No specimens were collected that can be associated with the known Palaeozoic rocks, nor is there any note of coarse basal conglomerates such as have been shown to occur between the Nubian and Palaeozoic rocks (*Q.J.G.S.*, *ibid.*, p. 344). Photographs taken in the Gilf Kebir suggest that at least the upper part of that great plateau consists of true Nubian sandstone, though P. A. Clayton, who has been responsible for much of the recent exploration of the Gilf, has accepted my suggestion that the lower part probably consists of Palaeozoic sediments.

From the data collected by the expedition it is possible to mark the Nubian Series on the geological map over a considerable part of the route covered. Exposures of typical Nubian sandstone were found in the great sandsheets between Bir Misaha and Laqiya and north of the Wadi Hawa. The most useful observations were made however in that wadi and south of it. Sandstones which seem to me to be typical of the uppermost member of the Nubian Series—the

[1] In the country around 'Uweinat similar quartz reefs run east and west (*Q.J.G.S.*, 1935, *ibid.*, p. 328).

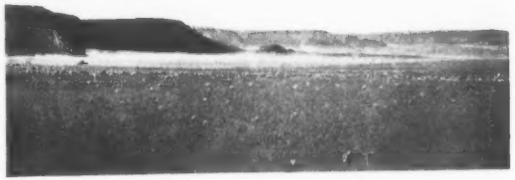


Granite outcrop and Nubian sandstone scarp E. of Merga



Falsebedded Nubian sandstone in Wadi Magrur

Margin of lava-flow N. of Meidob



Valley in S.E. part of the Gilf Kebir

Sand mounds covered with "tundub" in Lat. 18° 26', Long. 25° 20'

The Wadi Hamra

buff or brown falsebedded sandstones with fossil wood (*Q.J.G.S.*, *ibid.*, pp. 341–354)—were found far up the wadi in a small exposure not previously recorded north-east of Furawiya and along the wadi floor between long. 24° 25′ E. and 24° 47′ E.: these are coarse-grained, some specimens with rounded quartz pebbles, brown, buff, ochreous, and white in colour with ferruginous, and in most specimens calcareous, cement. Such sandstones, with the underlying clays and mudstones, are now known throughout the greater part of the Wadi Hawa from the vicinity of 16° N., 24° E., to the newly discovered exposures of the fundamental complex near, and east of, long. 27° E. between Jebel Tageru and Merga.

Perhaps the most interesting exposure from the geological point of view was found in Wadi Magrur, where it cuts lat. 15° 45′ N. Cliff sections here expose brown Nubian sandstone, falsebedded in the lower and middle parts of the section, with prominent conglomerates in the upper part: the evidence suggests that a considerable proportion of the pebbles in the conglomerate consist of remanié material from white and variegated or purple sandstones, mudstones, and shales. In 1932 we found the same relations of a remanié of these beds to the brown and buff falsebedded sandstones at Malha, and at several points north of it, but not so well developed. In the southern and central parts of the Libyan Desert we found this order of superposition and inclusion of older material in countless places. But south of the Wadi Hawa the mudstones and shales seem to thin out, to be overlapped by the buff sandstones and their remains to be wholly incorporated in the overlying sandstones in the Wadi Magrur–Malha–Sayyah district. The buff sandstones lie directly upon the fundamental complex, as we now see, from the frontier of French Equatorial Africa and the Sudan eastward, south of the Wadi Hawa.

3. *Volcanic Rocks.*—The most notable addition to our knowledge is the recording of prominent lavas, fresh in appearance, between the volcanic region of Meidob and Wadi Magrur, the wadi evidently skirting the edge of the flows in the vicinity of 15° 36′ N., 26° 23′ E. Such lavas, olivine basalts and their allies, are prominent near Malha, as old and dissected flows are north and north-north-west of Meidob, but the fresh appearance of those now recorded seems to suggest that a separate volcanic vent is somewhere in the vicinity. There is as yet no conclusive evidence as to the relation of lava flows to drainage lines—*i.e.* whether, as might be expected, the lavas fill old valleys, deflecting the drainage into new channels skirting the flows.

4. *Superficial deposits, etc.*—There is no need for me to call attention here to the various forms of sand accumulation, or to the red sand and *goz* country south of the Wadi Hawa. Old laterite (*marram*) has already been recorded and mapped (*Q.J.G.S.*, *ibid.*, pp. 366–369), and a specimen is included in the present collection from the vicinity of an outcrop recorded in 1932 (near J. Haigola, south side of Wadi Hawa). More important are the samples of black or grey mud collected from the floor of Wadi Hawa in 26° 15′ E. and 26° 45′ E., with lime pellets at the former: at the second place sand is mixed with the mud and the deposit is probably of no great age, in fact a normal "pan." The other specimen recalls a sample that I collected in 1932 from *beneath* the *goz* (red sand, stabilized) between Sayyah and Madu. In fact I am beginning to associate the mud of some of the pans and wadis in northern Darfur and on the flanks of the continental watershed with the *marram* or old laterite: in other words some of the mud, rederived in the pans and *rahads*,[1] may, I believe, be original "cotton soil" such as is now associated with laterite formation in southern Darfur and elsewhere in and near the tropical rain belt.

[1] *Geogr. J.*, vol. 85, 1935, pp. 422–3.

In this connection we may note the extensive areas north of the Wadi Hawa, but between the continental watershed and Merga–Bir Natrun, in which unstabilized, or scarcely stabilized, yellow dune sand conceals mud "pan" swarming with freshwater shells. The present expedition has found another area of similar shells among the dunes in about 18° 54′ N., 25° 16′ E. An extensive mud flat, crowned by two enormous tundub clumps, on the surface of which lime concretions of the size of a pigeon's egg abounded, is also situated in 18° 26′ N., 25° 19′ E.

Well-formed specimens of the snail *Pila ovata* Oliv. were collected from the second site, and the same species was also found in the Wadi Hawa at about 26° 15′ E., together with the large freshwater "mussel" *Aspatharia caillaudi* (Mts). Moreover the non-desert gasteropod *Limicolaria*, collected in 1932 in the Murdi Depression and in the Wadi Hawa north of the Teiga plateau, was found in large numbers, up to 3½ inches long, in the same wadi at 17° 07′ N., 25° 15′ E. Another shell, the common African species *Lanistes carinatus* (Oliv.) was found farther east along the wadi, on its south side, north of J. Tageru: as far as I know this is the first record of some of these species from the region.

It transpires, then, that valuable additions have been made to our knowledge of the distribution of shells of non-arid species in the Wadi Hawa and in the plains to the east of the Ennedi highlands. It is clear that in the latter situation the shells can thrive only in periods of good rains: at other times there is insufficient moisture. I suspect that *Pila ovata* probably survives years of drought in the midst of the huge tundub clumps located at 18° 26′ N., 25° 19′ E. The problems and deductions arising from this distribution have already been discussed in a paper now in process of publication by the Geological Society of London ("Observations on the Distribution of Land and Freshwater Mollusca in the Southern Libyan Desert"). The shells from the whole of the sites now known have been identified by Major M. Connolly at the British Museum.

APPENDIX III: METEOROLOGY

W. B. Kennedy Shaw

The following observations were made daily at 0800, 1400, and 2000 hours, as regularly as other calls upon our time allowed: Direction and force of wind (measured with a small anemometer), type, direction, and percentage of cloud. The best idea of the temperatures experienced will be obtained from the records made at the above-mentioned hours when the aneroids were also read for the determination of altitude. All the data obtained were handed to Mr. L. J. Sutton, Director of the Meteorological Service, Egyptian Physical Department. Until his accident the observations were made by Strutt, thereafter by McEuen.

The lowest temperature thus recorded was at Pottery Hill, lat. 24° 26′, long. 27° 39′, on January 21,—39° F. at 0815 hours. The highest was 102° F. at 1400 hours on March 19 in lat. 17° 50′, long. 27° 50′. Apart from these extremes the temperatures did not vary greatly from day to day during the whole three months. From January 14 until the end of February the morning (0800) temperature averaged about 55° F., with extremes of 39° F. on January 21 and 70° F. on January 28. The midday (1400) readings for the same period averaged about 80° F. with extremes of 65° F. on January 21, and 94° F. on February 12. About March 3, in lat. 15° 30′, the weather became much warmer, with midday temperatures of 90° F. or higher and morning temperatures of over 60° F. until March 20. After that date it again became cooler, averaging 75° F. at midday

and remained so until the end of the expedition. The temperature was noticeably higher when we were in the neighbourhood of the Gilf Kebir from January 23–30.

Apart from a spell of south-east wind from January 25–28 the prevailing wind was between north and east. The 110 wind directions recorded between January 19 and April 5 were as under:

N.	NE.	E.	SE.	S.	SW.	W.	NW.
25	40	16	6	5	7	7	4

Higher temperatures were on the whole recorded when the wind was between north-east and south-east, though on the two hottest days—98° F. and 102° F. on March 13 and 19 respectively—the wind was north-north-west.

Mr. Sutton has sent me the following note:

"The meteorological observations show the extent to which the weather in the Sahara is affected at this time of the year by the passage of depressions. Most of those which cross Egypt from the Libyan Desert are associated with the passage of a larger depression along the Mediterranean, and usually there is a pronounced cold sector. In advance of the depression the winds are south-easterly and always very dry, the humidity sometimes falling to only 2 or 3 per cent. In January these winds may be cool, but as the year progresses they become much warmer, and temperatures of 118°–120° F. have been recorded in Egypt in June under such conditions. These depressions are extremely rare after the middle of June. When the wind is at all strong a considerable amount of sand is raised. Owing to the extreme dryness the tender young leaves of trees and blades of grass often shrivel up and die as though frosted. These conditions of dry hot southerly winds, sometimes accompanied by severe sand-storms, are known as *khamsin*, an Arabic word meaning "fifty," referring to the period of fifty days after Shem el Nassim—the Coptic Easter Monday—during which they are most prevalent. On the arrival of the cold front of such a depression the wind rapidly changes to north-west, the temperature falls and the air becomes much damper. As a typical instance: on one occasion in March 1915 the temperature at Alexandria fell by 32° F. within two hours, while the humidity rose from 2 per cent. to 88 per cent. It is not uncommon for the cold front of a Mediterranean depression to traverse Egypt and the Sudan almost to the equator in the course of two or three days while the centre of the depression is passing from Cyprus to northern Iraq.

In Upper Egypt and the northern Sudan meteorological stations are necessarily confined to the valley of the Nile, apart from those at the oases of Siwa, Baharia, Dakhla, and Kharga. The observations of this expedition show the effect 500 kilometres or so into the desert west of the Nile of the passage of these depressions.

The low temperature, 39° F., recorded at Pottery Hill in the morning of January 21, was observed on the southern side of an anticyclone over Lower Egypt. The south-easterly winds in the vicinity of Jebel 'Uweinat during January 25–28 were blowing into a depression which approached Egypt from the interior of Tripoli and passed over Middle Egypt, where light rain fell. On February 3 the cold front of a Mediterranean depression traversed Egypt causing a sharp fall in temperature, with light but widespread rain, and was responsible for the strong north-east winds at Selima. On March 15 a deep depression arrived over Cyprus with a smaller depression, which had crossed Lower Egypt from the Libyan Desert, over the northern Red Sea. By the following morning the northern and most of the central Sudan, including the position of the expedition in lat. 17°, long. 27°, lay in the cool sector, the arrival of the cold front

there being marked by a sandstorm. The bad sandstorm of the 20th was also associated with a cold front which moved very rapidly southwards over Egypt and the northern Sudan following the passage to Iraq of another pair of depressions. The sandstorms of March 29 and April 1 were due to similar causes. Your meteorological observations give us the best series of desert observations which have come to my hands from any of these exploration parties."

APPENDIX IV: NOTES ON NATURAL HISTORY

MICHAEL MASON, F.Z.S.

That life should exist at all, under desert conditions, sometimes seems miraculous. One continually marvels at the amount of life a barren, waterless waste of sand can support, and one is driven to the conclusion that the addax—a heavy beast, usually fat—inhabited the land before it became the desert it now is. He simply stayed on, adjusting himself to the changing conditions of slowly increasing drought, until now he thrives from birth till death from old age, on pasture so scanty that it is hardly visible, and no water at all. Similarly thousands of small birds migrate annually through the desert. Many die upon their way, but that hundreds survive is proved by the continuance of the practice. It must be presumed that their forbears followed the same lines of travel when the Libyan Desert was a watered country. Wild things are loth to change their routine.

The following animals we found living under waterless conditions; some of them certainly do so for the whole year round, the rest probably for the four months of winter: Addax, Addra Gazelle, Dorcas Gazelle, White Oryx, Barbary Sheep, Giraffe, Red Huzzar Monkey, Ant-bear, Porcupine, Jerboa, Gerbil, Hyrax, Hare, Lion, African Hunting Dog, Striped Hyaena, Jackal, Fox (Cheetah and Civet Cat as doubtful names: we cannot swear to these).

The domestic beasts of the Kababish Arabs which can live without drinking for months, on good pasture and without work, retaining their fatness and continuing to give milk, are the camel, the ass, the goat, and the sheep.

With wild birds it is not often possible to be sure that they do not fly to man-made wells which large animals could not approach, but we concluded that the following birds do exist without drinking for very long periods, if not for all their lives: Ostrich, Greater Bustard, Owl (two kinds), Red Desert Buzzard, Desert Lark (two kinds), White-rumped Black Chat, Grey Chat, Grey Martin, also one or two not identified. Sand-grouse we saw, but never far from water.

There is no dew at all, at any time, in the desert where these birds and beasts were found.

Notes were made on all birds seen, migrant or resident, and on all locusts seen.

With our collection of birds we were unfortunate. Modern organized transport between sea-ports betrayed us. Everything arrived in Cairo in perfect condition, but the cases were delayed at Port Said until all the birds were ruined by beetles. Some of the mammal-skins were also spoiled.

The mammals brought home included: Red Huzzar Monkey (*Erythrocebus patas*). This animal was collected north of Wadi Hawa, 300 miles from the nearest open water.

Fennec Fox (*Fennecus zerda*). A series of these tiny foxes from several parts of the desert showed local differences.

Rüpell's Fox (*Vulpes rüppelli*). These larger desert foxes were caught in Selima Oasis.

Common Gerbil (*gerbillus gerbillus*). These were collected in many parts of

the southern desert. One from Jebel Tageru was much larger than the others, with smaller ears.

Jerboa (*jaculus jaculus*). We only saw these in the grass-desert of the south.

The Fennecs are the most important specimens of the collection, representing the first series collected from the Wadi Hawa region.

The problem of how beasts manage without drinking was much in our minds, and in parts so remote from water that drinking was quite out of the question one is forced to the following conclusions. The addax, gazelles, monkeys, etc., get enough moisture from grass and twigs, occasionally varied by colocynth gourds. The lion and wild dog get their moisture from the blood, lymph, and urine in the bodies of their prey. But the hyaena and the jackal generally find the carcass dry. Whether death is from old age or by beasts of prey it will, in most cases, be shrivelled or "kippered" by the sun before they get to it. The hyaena we killed and the many jackals we saw were fine specimens in good condition. Where do they get moisture?

Twenty-two genera and forty-three species are represented in the collection of insects. Of these three species are not represented in the British Museum collection, and one, of the Hemiptera, is probably new.

DISCUSSION

Before the paper the PRESIDENT (Major-General Sir PERCY COX) said: My lords, ladies and gentlemen, The paper to-night, as you see, deals with a journey in the Southern Libyan Desert. Mr. W. B. Kennedy Shaw, who is to address you, is well known to the Society. He has done a great deal of exploring work in the Libyan Desert, taking part in several expeditions in that region. Two years ago, it will be remembered, he and Major Bagnold carried out a fine piece of work together, and on their return Major Bagnold was to have read us a paper, but he being posted to China on duty, Mr. Shaw read the paper on his behalf. Mr. Shaw was himself awarded the Gill Memorial Award last year, so that it is a distinguished Fellow whom we welcome here to-night.

As I have had occasion to observe before, fields awaiting further exploration are shrinking and most that remains to be done must be sought either in the polar regions or the great deserts, and there has been and still is, I imagine, a great deal to do in the Libyan Desert in the way of completing its exploration. To-night Mr. Shaw will tell us of the very interesting journey he has made, one which has had good results in several directions, touching on various departments of natural science. I will ask him to read his paper.

Mr. Shaw then read the paper printed above, and a discussion followed.

Mr. M. H. MASON: Mr. President, I did not expect to have to say anything to-night, and there is really nothing in particular that I have to contribute. If I had a job at all, beyond pulling the cars out of the sand when they stuck, it was as the naturalist to this expedition, in common with Colonel Strutt, and after his death I carried on alone. I am not a naturalist, but only a person who is fond of animals. One interesting point which came out of this expedition to the Libyan Desert was not so much the capacity of some animals to do without drinking water—I will not say without moisture—but rather their capacity to gather the obviously essential moisture from sources which were not apparent to the human observer. We discovered the addax and other animals a very long way from any vegetation visible to the casual eye. Some distance north of the Wadi Hawa we came upon numbers of ostriches and gazelles. We saw the tracks where they picked about, and one wondered what they found. But if we brought our eyes down to within 2 feet of the ground we noticed a tinge of

green, and occasionally there was a grass blade. There was about one grass blade to every 2 square feet. The natives of Wadi Hawa said that no hyaenas were known, but lions were known and we found underground burrows used by them—rather like rabbit burrows on a different scale—and we crawled into one of these, a singular experience.

Another thing that struck me was that a lion can get enough moisture from inside the body of the creature it has killed, but while the lion gets moisture from the antelope and the wild dog gets it from whatever it kills, I should like to know from where the jackal gets the moisture, because by the time the jackal gets to the carcass it is dry. One rather strange thing we noticed, namely, that when an occasional shower of rain comes to a district which may not have had such a shower for ten or twenty years, some grass immediately comes up, as though the seeds had been lying in the dry soil all that time immediately underneath the surface, waiting for the shower. There are kangaroo rats which live in the Desert—pretty little things—and there may not have been any others around them for 100 miles. They could not have come down with the rain or up from the dry soil. Where do they come from?

The PRESIDENT: There will have occurred to many of us in this connection the journey of Hassanein Bey. We are very delighted to have the pleasure of his company to-night. To-night's lecture must have brought back to him many recollections of his own fine journey in 1924 through Kufra to Darfur. For that journey he received the Founder's Medal of this Society. I hope he will come on the platform and address us for a few minutes.

Sir AHMED HASSANEIN BEY: Mr. President, ladies and gentlemen, I must thank our President for having called upon me in such very kind and complimentary terms to say a few words to you on Mr. Shaw's most interesting and instructive lecture. I not only congratulate Mr. Shaw on his charming lecture, but I thank him very much because he brought back to me with his vivid descriptions and excellent slides the Libyan Desert once more. It is quite true that I have travelled in the Libyan Desert, but that was years ago; since then distinguished and intrepid explorers have led expeditions in the Libyan Desert with much more important and valuable results. Year after year since 1926 I have had the increasing feeling of being quite a back number. But I must confess that not until this evening, with the description of this journey, did I realize that I have become entirely mediaeval. All my journeys in the Libyan Desert were made by camel caravan, and I am pleased to hear that, modern methods of transport notwithstanding, the camel has still been of use in dumping petrol for the expedition. I might add that although there are bits of desert where the camel cannot go and the car can, there are a good many bits where the camel can go and the car cannot show its face. There is also something to be said for the slow pace of the camel, 3 or 4 miles an hour, because it gives one leisure to look around and note the points of interest in one's surroundings. Please do not think I am making propaganda against the car, for although I do not like inanimate transport, I recognize that the exploration of the last nine years in the Libyan Desert could not possibly have been covered by camel carrier. You may understand how small I feel to-night with my 2300 miles covered in eight months, compared with Mr. Shaw's more than 6000 miles in about three months.

There were two points of particular interest to me that were mentioned by Mr. Shaw. One is his reference to the name Wadi Hawa, which on the Sudan sheets is usually written with the "r"—"Howar." I was curious to know the derivation of the name. I asked some of the local men about the extension of the valley eastwards, and they believed that it joined the Nile Valley at Omdurman. They even said that messages enclosed in drums used to be sent in the

old times by the Zaghawa through the valley during the floods. The other point was about the rock drawings which we also found, and many of which have been found by previous explorers. Such drawings have also been discovered in West Africa and in South Africa, and as far north as Spain. I hope that one day a research student will arise who will collect and collate all this information and make a really interesting résumé of it, revealing the importance historically of the people who made these drawings and of the period in which they were made. An interesting point, as Mr. Shaw has mentioned, is that some of these animals are depicted as domesticated. That may easily have been possible in this region, not only a few centuries ago, but even within the last fifty or sixty years. I remember on a previous trip to the one of which I have spoken we were passing through a region north of Kufra, and came to the place where Rohlfs about sixty years ago, passing on his way to Kufra to the westward of Zieghen, had described a broad stretch of vegetation. When I saw it in 1921, on the journey with Mrs. Rosita Forbes, there was nothing but dead brushwood, and the fact that we had expected on Rohlfs' story to find vegetation and found none nearly cost us our lives. I was perplexed about it, but when I was there on my last trip the head camel man told me that in the good old days he used to go out there with his father to graze their camels. I asked him how there could be any grazing in such a spot, and he said that this was grazing ground, however difficult to believe now, and that people from the north used to graze their camels and rest them there. It was also stated that in Kufra itself there was at one time grazing ground for camels. The reason why the natural appearance had changed was attributed to the prayer of a Senussi chief, who prayed that there should be no rain, that the Badawin might have no grazing to fight one another about.

I am afraid that Mr. Shaw in his charming lecture has misled us a little, because he has discounted the dangers which he and his companions had to meet. The Libyan Desert is by no means such an easy stretch to get through as might be supposed. It is a most dangerous kind of exploration, and camels are safer than cars, because the camel scents danger and nothing will induce it to go forward, whereas, as the last expedition bears sad witness, accidents happen with cars, and of course there is also the danger of lack of petrol. It speaks very highly of the ability of the members of this expedition to have pulled through it; it was by no means easy, and I advise any of you who contemplate going to the desert to think more of camels than of cars.

The PRESIDENT: Major Bagnold, you remember, gave us a paper on his last expedition, which Mr. Shaw read in his absence. He has recently made a great study of the behaviour of sand, and spoke to us in very interesting fashion on that subject.

Major R. A. BAGNOLD: I should like to begin by offering my congratulations to Mr. Shaw on his most successful expedition, not only on the running of the expedition itself, but on the success of the results. I think I am right in saying that it is the longest desert expedition that has ever been made. I should also like to mention one or two things that Mr. Shaw did not say, and to point out what a small motor expedition of this kind means. Mr. Shaw ran the expedition. His whole day was taken up, when he was not himself driving the car, in navigating, that is, in sitting next the driver and noting the bearings and the speedometer readings every minute or so, and at every halt plotting out on a bit of paper the route which the expedition was taking. Directly he got in at night he had to help with car maintenance and with all the ordinary things one has to do in camp. Then, after everybody else had gone to bed, he must stay up for an hour or an hour and a half longer taking theodolite observations and

working out laborious calculations to fix the position of the camp. This routine had to be followed perhaps every day, so that it must be realized that these expeditions are not just a nice holiday. There is a tremendous amount of work entailed. When Mr. Shaw and I went on our expeditions I was lucky, for he did all that work for me.

I should like to echo Mr. Mason's words, "Where do they come from?" I remember camping on the eastern side of the Gilf Kebir. We had not seen any vegetation for 700 miles, and yet on turning on the headlights of the car a little swarm of flies was attracted. As far as we knew there was neither vegetation nor any living thing for 300 miles farther on. The answer to the question where they came from may be connected with vegetation which is scarcely apparent above the surface, but in this region so much that is unexpected has been discovered that one is never quite certain what else may be found just over the next horizon to upset all one's ideas.

Mr. Shaw mentioned my work on sand movement. I have to thank Mr. Shaw for the trouble he has taken in collecting for me samples of sand from all over the desert. I have an artificial desert in a long wind tunnel where the movement can be measured under controlled conditions. Many interesting facts are coming to light, but I won't bother you with them now. I will only offer my congratulations to Mr. Shaw both on his achievement and on his lecture.

The PRESIDENT: I will ask Dr. Sandford to speak. Dr. Sandford, who has travelled in the Libyan Desert and in a good many other places, is Demonstrator and Lecturer in Geology at Oxford.

Dr. K. S. SANDFORD: Mr. President, ladies and gentlemen, I want to congratulate Mr. Shaw on a very interesting journey which has filled up a number of blanks on the map of the Libyan Desert. He has filled up indeed more than his fair share of blanks, and if he goes on at this rate soon there will be none left.

A word about the geology. Mr. Shaw is the only non-geologist I know who collects really useful geological specimens. He brought back a number of bags of rock which he handed over to my tender mercies, and without exception they were useful. Usually people who try to collect geological material bring back highly coloured crystals of quartz or pretty things which are useless to geologists, although they might be of some use to a jeweller. The great difficulty seems to be to collect the common rock which makes up miles and miles of country and to discard, or treat as a secondary consideration, the curiosity which probably is of no use. Mr. Shaw has done this with tremendous success, and as a result the geological map of the territory has been amplified. One of his companions, Mr. Mason, has, I believe, studied geology, but I am told that he sat back, said nothing about it, and let Mr. Shaw do the collecting. At any rate the results were of great utility.

Finally perhaps I might add a word about the archaeology. I was very interested to hear Sir Ahmed Hassanein Bey say that the Desert had got worse from the point of view of supporting any agriculture. I think that it is getting worse, and perhaps is worse now than it has been for a very long time. Only a few years ago Hassanein Bey successfully took a horse with him over a stretch of country where, in 1932, there was not a blade of grass and it seemed ludicrous to take any animal, even if grain or fodder were carried. But in a few years the vegetation may come back.

Mr. Shaw has mentioned the distribution of skeletons and querns. I noticed in this area in 1932 that the stones for grinding corn were extremely well finished and smoothed on the underside. They were of a shape very convenient to carry about. Some of the querns and other instruments that I saw were not of local

sandstone at all. There is, I think, a good deal of evidence that the people went into that country to graze their animals, not to carry on agriculture, and that they took their querns with them,[1] being uncertain what stone they would find. I am very doubtful whether they grew corn there. I think it is much more probable that they took it with them, ready to grind as required. Probably they went there for a part of the year only for the grazing, as the nomads still do far to the north of Wadi Hawa near the continental divide. I congratulate Mr. Shaw on a very successful expedition.

The PRESIDENT: Ladies and gentlemen, I think we must close the proceedings now. We have heard some very interesting observations from the several speakers. Before I ask you to thank Mr. Shaw you will I am sure wish me to give some expression of the great regret which I feel, and which I know you share, at the sad accident as the result of which Colonel Strutt lost his life. From what the lecturer has told us, Colonel Strutt must have been a very fine character. I had not the privilege of his acquaintance myself.

As to the lecture, I heartily congratulate Mr. Shaw and thank him, not only for his interesting and informative paper, but for the results he has brought back, which are evidently of great value in many directions. It is clear that there is a considerable amount still to do, and Dr. Sandford has rather expressed the hope that it may not be done too quickly, and that the Libyan Desert may still remain for some years to come an accessible field for exploration.

I ask you to join with me in congratulating Mr. Shaw heartily on his journey and in thanking him for the charming way in which he has told us about it.

The vote of thanks was accorded with acclamation, and the meeting terminated.

[1] After the lecture Mr. and Mrs. A. E. Robinson confirmed this observation: the Ababda still carry Nubian sandstone querns from the plains into the Red Sea Hills and to the coastal belt.

THE WAHGI RIVER VALLEY OF CENTRAL NEW GUINEA

K. L. SPINKS

THE Wahgi River valley forms part of the Purari Plateau of Central New Guinea, and accounts of the discovery and exploration of this Plateau are recorded in the *Geographical Journal* of November 1934. These accounts deal briefly with a general description of the Purari Plateau and of the activities of the exploration parties. It is intended in this article to discuss the physiographical features of this region and its discovery relevant to the development of New Guinea. (See Folding Map at the end of the *Journal*.)

Historical

The eastern portion of New Guinea has been colonized since 1884, in which year Papua became a British possession and North-Eastern New Guinea was acquired by Germany. This latter part of the mainland now comprises part of the Territory of New Guinea administered as a mandate by the Commonwealth of Australia. To summarize the developmental exploration carried out since annexation reference is made to a report on "The Salient Geological Features and Natural Resources of the New Guinea Territory" prepared by Evan R. Stanley, F.G.S., in 1921. This report is included in the Annual Report to the League of Nations on the Administration of New Guinea, covering the period from 1 July 1921 to 30 June 1922.

The coastline of North-Eastern New Guinea has been charted by numerous navigators since the early seventeenth century, although the charts in use are those prepared from Admiralty surveys carried out towards the close of the nineteenth century. Most of the mountain ranges shown on the present-day maps of New Guinea were fixed and named by these later navigators. During German occupation, very little exploration was carried out on the mainland, only the coastal areas of navigable rivers having been traversed, and it was not till 1913 that any serious attempt was made to explore the unknown hinterland. During the Great War and the years following capitulation, no exploratory work was carried on until a scientific expedition, sponsored by the Commonwealth of Australia, visited New Guinea in 1921. After a lapse of several years the discovery of gold and the subsequent search for new goldfields opened up much new country along the Markham River tributaries and in 1932 attention was turned to the unexplored central portion of New Guinea.

Accessibility of the Main Plateau

Access to the Purari Plateau is provided along the Yuat (Dorfer) River, the Purari River and Papuan streams rising south of Mount Hagen, and the Upper Ramu River. All these streams are navigable by small boats for some considerable distance, and exploration usually ceased at a point where progress by boat was no longer possible. This was usually due to the presence of rapids or waterfalls situated in mountainous country and, as the boat parties were not equipped for further travel by foot, it was generally assumed that the headwaters of these rivers had their source in the central mountain range. A

typical example is that of the exploration of the Yuat River by Administration officials and prospectors. It was believed that this tributary of the Sepik River rose in the Schrader Range, whereas it is shown on the accompanying map that the headwaters of this stream drain the country more than 40 miles to the south-east of its supposed source. In attempting to follow the Yuat River from its junction with the Sepik River, travellers had been turned back from where the Yuat River emerged from the Schrader Range and as a result this way was closed to further exploration for many years. Upstream from the furthest known point the Yuat River passes through mountain gorges and no native population is to be found for a distance equivalent to five days' march. The lack of native food supplies would prevent any party ignorant of that fact from following the course of the Yuat River upstream and indeed a journey downstream through the gorges at the present time is attended with many dangers when it is remembered that travel in New Guinea is dependent on native carriers.

Exploration parties along the Purari River and other Papuan streams met with obstacles similar to those encountered in the exploration of the Yuat River, and consequently further attempts were not made to penetrate the hinterland via these streams.

The Upper Ramu area has been settled only since 1930 and prospecting parties travelling westerly from this district entered the eastern portion of the Purari Plateau. Further development in this area led to the discovery of the Wahgi River valley, but in this connection only the co-operation of ground parties with aeroplanes rendered exploration work possible.

Tectonic Features

Geological investigation with regard to earth movements and structural geology was carried out by E. R. Stanley in 1921 and the geological information, generally, is given with acknowledgment of his report.

Earth movements on an enormous scale took place in New Guinea during late Tertiary times, commencing probably in late Miocene and culminating in late Pliocene or early Pleistocene times. Folding has generally been responsible for the formation of the Main Range, a series of high ranges, peaks, and clusters of mountains, situated in central New Guinea. Tectonic faulting on a large scale has taken place and the courses of many of the large streams of the mainland lie in the direction of extensive fault zones. According to Stanley, the main orographical feature, which passes longitudinally throughout New Guinea, extends in part from the Victor Emanuel Mountains eastward to Mount Hagen and then unites with the Bismarck Range. Thence the Cordillera passes along to the Kratke Mountains and on to the Owen Stanley Range in Papua. It was not known that an extensive plateau, drained by large streams and flanked on the south by mountain ranges rising to 14,000 feet, existed in the interior. In the light of the recent discoveries in the Purari Plateau, the Main Range appears to continue easterly from Mount Hagen along the Kubor Mountains towards the Kratke Mountains, situated south of the Upper Ramu River, and it is probable that the Bismarck Range constitutes a parallel range.

The Purari Plateau is characterized by general, extensive uplifting with the

accompanying development of block-faulting, probably more normal faulting than thrust-faulting. Previous theories presupposed a great deal of thrust-faulting in New Guinea (*see* 'Geology of the Commonwealth,' by Professor T. Edgeworth David). The Kubor Mountains, which form the southern watershed of the Wahgi River, are limestone capped and the southern slopes of these mountains rise gradually from the coastal area drained by the Purari River headwaters. The greatest altitude attained is 14,300 feet, and on the north the mountains fall steeply to the level of the Wahgi River valley. The Hagen Range and Mount Giluwer, 14,500 feet, are of volcanic origin and are probably subsequent to the general uplifting. Lava flows from these two centres of activity are found along the valleys drained by the Kaugel, Nabilyer, Baiyer, Gai, and Jimmi Rivers, and the waters of these streams have cut deep gorges through tufaceous material and volcanic breccia. Along the Nabilyer River in latitude 6° 10′ S., massive slates are exposed, dipping south-east at 52° and overlaid by breccia to a depth of 300 feet. The area easterly from Mount Hagen to the swamps at the head of the Wahgi River is also covered with breccia deposits which are exposed in the numerous headwaters of the Wahgi River. There is much local magnetic variation on the top of Mount Hagen due to the presence of magnetic minerals in the surface rocks.

The mountains forming the divide between the Jimmi and Wahgi Rivers are composed mainly of intrusive rocks; metamorphic rocks are to be found near the Jimmi River to the north. The excellent stone axes which the natives use are usually made from felsites from this region.

Easterly along the Wahgi River valley near the Chimbu River, limestones predominate and fossils collected by the writer were determined to be of Miocene age with the orbitoides group and other foraminifera abundant. They are like the lepidocyclina limestone of Bootless Inlet, on the Papuan coast. Uplifted limestones of this part of the Purari Plateau are probably the highest in New Guinea. A little farther easterly in the China Shiva district, extensive deposits of grey-black shales of sedimentary origin are exposed. In the vicinity of Mount Irimbadi, limestone caves are found which are sometimes inhabited by natives. The courses of several streams in this locality flow underground in the limestone formation.

The Wahgi River valley for the most part is covered for a considerable depth with fluviatile deposits and extensive alluvial fans formed where mountain streams debouched on the valley.

Mountain Names

As already mentioned, early navigators and coastal explorers mapped and named the mountains of the hinterland of New Guinea. Of these the Hagen Range and Mounts Wilhelm, Herbert, Otto, and Helvig of the Bismarck Range are situated in the vicinity of the Purari Plateau. Well-defined mountains were found to occupy the charted positions of Mounts Otto and Helvig, and there can be no doubt about these mountains. This is probably due to the fact that their proximity to the coast and the coastal configuration enabled navigators to obtain landward bearings which provided good intersections. With respect to Mount Wilhelm, 14,000 feet, and Mount Herbert, 13,000 feet, there is considerable doubt. The Bismarck Range in these parts is a high

mountain block, the top of which lies at a general elevation of 13,000 feet. In the absence of descriptions of these mountains, and considering that a general similarity of appearance prevails, it was found impossible to identify Mount Wilhelm and Mount Herbert according to their charted positions. Two of the more prominent points as seen from the Wahgi River valley were fixed, and, as the natives had names for them, those names, Oundarn (12,500 feet) and Yendeiwer (14,000 feet) were adopted for the accompanying map. (See Folding Map at the end of the *Journal*.)

The Hagen Range is shown situated in longitude 144° 30′ E. and lat. 5° 30′ S. on Admiralty charts, but no high mountains were found in this position. However the altitude and prominence of the isolated mountain block known to the natives as Muil would make it visible from the Sepik River basin and the north-eastern coast, and it is considered that Muil corresponds with the Hagen Range.

The Kubor Mountains were not discovered till 1933. Several prominent points were fixed in the course of mapping the Wahgi valley, and Mr. J. L. Taylor, a member of the exploration party, exercised his privilege as an Administration Officer to give European names to them. It is the writer's opinion that they should bear the euphonious names by which they are known to the natives of the Wahgi River valley. Moreover these names allow of immediate identification by reference to the natives themselves.

The discovery of the Wahgi River valley has opened up an extensive field for scientific work. The search for gold, which however has not yet been found in payable quantities, has been continued, and native affairs have received the attention of Administration officers and missionaries. It is hoped that, with the development of the Territory of New Guinea added transport facilities will encourage further investigation of the resources of this extensive region.

Note by the Editor on the map accompanying the preceding and following papers

IN the *Journal* for November 1934 we published two papers on Central New Guinea: "Mapping the Purari Plateau," by Mr. K. L. Spinks, and "The Central Ranges of the Mandated Territory of New Guinea from Mount Chapman to Mount Hagen," by Mr. E. W. Chinnery. The former was received on 9 July 1934 and was accompanied by a map; the latter was received on 27 July 1934 and had also a map covering a good deal of the same area. This latter map was based in great part upon Mr. Spinks' surveys, and where the two differed it was understood, but wrongly, that the second was to supersede the first: whereas in fact Mr. Spinks' map was later in date and more complete. We are glad to have an opportunity now of remedying this mistake. Mr. Spinks' paper of November 1934 gave a careful account of the pioneer journeys made by prospectors, surveyors, and administrative officers during the years 1930–33, and conspicuous among the prospectors was the name of Mr. Michael Leahy. Early in the autumn of 1935 we received a visit from the brothers Michael and Daniel Leahy, who brought with them to England an immense collection of photographs, a fine selection of weapons, detailed diaries of journeys made between Salamaua and the Upper Gai River, and a certain number of unplotted compass bearings. One of the Society's draughtsmen, Mr. Jordan, was at once set to work to plot the compass bearings and wherever possible to resect the positions of the points from which the principal panoramic photographs had been taken. Using Mr. Spinks' map as a framework he was able to sketch in from the photographs and Mr. Leahy's descriptions of them the detail in the hill-shaded areas upon the map and to make some extensions to the outline in the basins of the Gai River to the north-west and the Tua River to the south-east.

At a special evening meeting of the Society on November 21 Mr. Michael Leahy gave an account of the remarkable people whom he had visited on his journeys, illustrated with admirable photographs and moving pictures. As a preliminary to publication he had made careful extracts from his diaries and summaries of early journeys, and it seemed best to preserve in what follows the form of diary, which is both precise and graphic. Mr. Leahy was unable to remain in England to see the completion of the map and to read the proofs of his paper. It will be fair, then, to impute any errors which may appear to the Editor rather than to the Author.

While the work on Mr. Leahy's material was in progress we received from Sir Hubert Murray, Governor of Papua, a typed report of the journey made last year by Mr. Hides in the northern part of Papua, with routes and some additional detail and names inserted on the western sheet of the map of Papua printed by H. J. Green, Government Printer, Melbourne, in 1932. Working east and north from a base on the Strickland River Mr. Hides had, he believed, approached the border in long. 143° 30′ E. and then worked south-east to 144° E. in about 6° 20′ S., whence he went south to the Kikori. If these figures are correct he must have crossed the country shown on our map between Keluwere and Yalbu. But we have not been able to find any agreement between the detail we have plotted from Mr. Leahy's bearings and

photographs, and the rivers and names inserted by Mr. Hides on the map of Papua: nor does his description of the tribes and their houses suggest that in this region his route had crossed Mr. Leahy's. It seems possible that the detail on the map of Papua has been displaced somewhat to the north by the tendency to overestimate distances from the coast in difficult country, and that at least a great part of Mr. Hides route in this area lay just south-west of the area plotted approximately on our map from Mr. Leahy's material. Neither traveller determined any positions astronomically himself; but unless we have failed altogether in adjusting Mr. Leahy's detail to Mr. Spinks' framework, the solution suggested above seems the most probable.

A few days only before this note was passed for press we received a further letter from Sir Hubert Murray, enclosing a copy of a letter from Mr. Hides to His Excellency, to accompany a map compiled by Mr. Stanley of Oil Search Limited, in which he had plotted the route of Messrs. Spinks and O'Malley in relation to Mount Hagen, and the country in Mandated Territory examined by Messrs. Leahy, Spinks, Taylor, and others. We had then to decide whether to defer publication of the material in this number of the *Journal* until we received the promised copies of this map, or to proceed, with emphasis upon the foregoing explanation. After careful consideration the latter course was chosen. No account of Mr. Michael Leahy's extensive journeys has hitherto been printed, and until they are placed on record it is impossible to relate them to others, even tentatively. We can hardly expect that this difficult border country will be completely surveyed for some years; meanwhile any apparent discordances in the accounts of pioneer journeys may be considered natural and inevitable.

The spelling of place-names has presented a considerable difficulty: and the spellings provisionally used do not claim to be in any way definitive, nor to supersede those of Mr. Spinks or Mr. Chinnery. They are no more than a suggested method. The practice of the *Journal* is to follow the R.G.S. II system in the representation or transliteration of native place-names: and Mr. Leahy was kind enough to repeat the names occurring in his paper with great care, so that the spellings provisionally used in the text of his paper and many names on the map are founded entirely on his oral evidence.

A comparison of the two lists given below will show that where Mr. Spinks' spelling differs from the R.G.S. II representation of a name, differences are on the whole systematic and characteristic; and appear chiefly in the presence or absence of the letter *r* in the representation of indeterminate vowel sounds.

Leahy (R.G.S. II)	*Spinks'* 1933 *map*
Jimi	Jimmi
Ganz	Ganj
Nabilya	Nabilyer
Mogai	Mogei
Benambi	Benambei
Minj	Aminj
Jamga	Jamgar
Boiya	Boiyer
Kawbin Kundubi	Korbin Kundubi
Kawbinaberi	Korbinarbrei

Leahy (R.G.S. II)	*Spinks'* 1933 *map*
Kawbin Kina	Korbin Kinai
Mawgabinya	Morgabinya
Ogumanits	Ogumantz
Kaga	Carger
Kwilga	Kugilgar
Andimoima	Andimorima
Undan	Oundarn
Kunbi	Kunimbi
Mirani	Miranei
Kumukul	Kunmokul
Yendaiwa	Yendeiwer
Marifutiga	Mairifuteikar
Gawritufa	Goritufa
Bina Bina	Bena Bena
Tebinofera	Tebinifera
Gafatina	Garfetina

It will be remembered that Messrs. Chinnery and Spinks referred in earlier articles in the *Journal* (vol. 84 (1934), pp. 398–9 and 414) to the explorations of Captain Hermann Detzner. It is convenient to add here a short summary of Detzner's work, based principally upon his report in 'Mitteilungen aus den Deutschen Schutzgebieten,' Band 32, 1920, pp. 1–19, *Map*, and Band 36, 1928–9, pp. 112–130.

Early in 1914 Detzner was at work in the Upper Waria region, surveying a portion of the international boundary between German New Guinea and Papua. By September he had penetrated to the watershed in the neighbourhood of the Upper Tiveri and Mount Lawson. About 20 km. north-west of the mountain he passed from the hitherto prevalent clay-slate mountains into an area of limestone highlands: this transition was also marked by a change in the ethnographical character of the population, whom he recognised as a new element in the peoples of Papua. He describes them as stocky, powerfully built, and long-limbed men, having knots of hair in the centre of their shaven heads, with numerous yellow and black lines diagonally across their chests, and wearing grass skirts to their knees. Their weapons were bows and arrows, slings, and well-made stone axes. These are the second group of mountain people referred to by Chinnery in the article quoted above. Detzner pushed westward through this region along the boundary to the vicinity of "Mount Joseph," his furthest point being about 145° 25′ east. It is this area which was the scene of Patrol Officer J. K. McCarthy's journeys in March–April and August–November 1933 (*Geogr. J.*, vol. 84, pp. 401–05). The people of this thickly populated area are now known as Kukukukas. From his furthest point Detzner obtained views over the southern flanks of the central watershed, cut by numerous north to south flowing rivers, and formed the opinion that there were no insurmountable obstacles between him and the Lower Sepik. However he was obliged to abandon any intention of proceeding thither on receiving news of the outbreak of war. Later on, at the end of 1917, he travelled from the upper Ramu valley into the Bismarck range, north-west of the Kratke mountains, and continued along them in a north-westerly direction for about 100 km.

THE CENTRAL HIGHLANDS OF NEW GUINEA: *A paper read at the Evening Meeting of the Society on 21 November 1935, by*

MICHAEL LEAHY

FIRST JOURNEY, April–September 1930

THE many thousands of Stone Age natives which we found inhabiting the grass ranges and valleys drained by the Kartau,[1] Kamamentina, Dunantina, Bina Bina, and Gafuku Rivers, all tributaries of the Purari, although not generally big in stature, are a virile race. They are all bow-and-arrow fighters, using oblong-shaped wooden shields to protect themselves when fighting. The shield is sometimes carried on the back, the warrior moving crabwise, protected by it, towards the enemy, turning quickly at intervals to fire an arrow. As numbers of them have an eye shot out, we concluded that they were peeping around the shield at an inopportune moment, and so lost an eye. Their coverings consist mainly of a woven rope-like girdle round the waist. In the front is suspended a small piece of tough wood, cut to the shape of a huge butterfly with wings outstretched, to protect the private parts; long strings are also suspended from the girdle, being about 10 inches long in front and 4 inches at the sides. This front covering differs in some places, a piece of string net or just the string being suspended from the waist. The back covering for the most part is a few strings, a net bag suspended from their necks and reaching to their knees is considered sufficient. Farther down the Purari, below the junction of the Gafuku River, the men wear bunches of leaves suspended from a rope girdle at the neck and a strip of string net about 6 inches wide and 3 feet long doubled over the front; here they wore a band, up to a foot wide and made out of lawyer cane, around their middles as a protection against arrows. Everywhere their noses were holed in three to five places, pegs of wood being inserted and chains of tambu shells being draped over the pegs, or bright-coloured birds' feathers placed in the holes. Their ears were pierced and the holes enlarged, with small dried snakes, possums' tails, etc., suspended from them. Their hair in some places they wore in small plaits, the whole decorated with a plentiful supply of pig's grease, over which bands of shells, the green wings of beetles, bright-coloured berries, cassowary plumes, birds' wings, etc. Farther down the river in the sparsely populated bush country the men have few decorations and their dress is similar to that worn by the Kukukukas of the Langima–Watut River country.

The women for the whole length of the river we travelled wear few decorations in comparison with the men. Around the country in the headwaters of the river the unmarried girls wear a short string covering in front and rear, leaving the thighs exposed; the married ones wear a thick covering of strings teased out from a tough bark and suspended from the waist, covering the body from the hips to the knees. They, like most of the women in New Guinea, wear a net bag for carrying native foods, their babies, and in some cases the skull and bones of relatives, hung from their heads. They also have a custom of cutting off the top joint of a finger when any of their near relatives get killed in the frequent inter-tribal wars. All of these people are cannibals, and human

[1] See Folding Map at the end of the *Journal*.

flesh eating is quite a natural thing for them to do. A father, if his son is killed, would not partake of his flesh himself, but he will reverently bury his son's stomach, etc., and not hold any malice against his fellow-villagers for eating the flesh.

The gardens of the people inhabiting the headwaters and numerous tributaries of the Purari are probably the most scientifically worked of any native cultivations in New Guinea. The ground is first turned over by means of pointed sticks, then allowed to fallow for some time, then it is dug up again with pointed sticks, every weed or grass root being taken out and the soil rubbed into a fine mulch between the hands. It is then arranged in long, straight rows, a shallow drainage channel cut between the beds and their sweet potatoes, yams, beans, etc., planted. Looked at from a distance the general lay-out is symmetrically perfect. The people live in villages which were in most cases surrounded by a barricade of split slabs up to 12 feet high if timber were available; and in the country away from the timber-clad ranges, wild cane stalks woven together formed a very effective wall; at intervals along the barricades the wall extended outwards to allow the besieged villagers to protect the barricades against invaders. Getting in close to it and protected by their wooden shields the invaders would cut the vine binding it together and let in their comrades to burn the rounded grass-thatched houses and kill all to whom they could get near enough.

A most remarkable feature of the people of the Dunantina, Bina Bina, and Gafuku areas is the custom of forcing a doubled-up length of fine cane down their throats into their stomachs. We learnt that this is a rite which will make them strong fighters and immune from pain or wounds. Young boys or women of any age are not allowed to see this rite practised under pain of instant death.

In the vicinity of the junction of the Maki and Menepo, which we now know as the Wahgi and Purari, the houses change from rounded to oval shape up to 40 feet long, having doors one side. The men's houses are just a long room with fires at intervals down the centre, the natives sleeping feet towards the fire, their bows and arrows and spears alongside them. The houses of the women are divided into compartments, their pigs usually occupying one end of it. All are grass-thatched, and through the roof the upright supports extend some 3 feet and are decorated with grass and short lengths of a tree called nigger-heads, giving them the appearance of chimney-pots.

Saturday April 12: Left Salamaua, getting our stores in by carriers recruited from the villages in the Markham Valley to Gaitluren (Kainantu), a small village on the Ramu River.

Saturday May 24: We climbed out of the Ramu Valley to Lehuna, village on the eastern slopes of the Bismarck Range, 3000 feet above sea-level. Sunday we spent at Lehuna packing up to go over range into other fall, taking about a month's stores, food, trade, etc. Intend looking into the head of Ramu River and approximately west from there. On Monday we started off from Lehuna. Could not get any carriers or natives to show us a road. Climbed up to 9000 feet over the range and dropped down the other side about 2000 feet and sighted grass ridges 3.30 p.m. in afternoon. Grass ranges as far ahead as we could see. Dropped down another 1000 feet into the stream below,

since proved to be the head of the Dunantina River. Camped alongside the cargo. A few natives about on top of the grass ranges.

May 27: Kanakas sighted us at daylight, so not sure how they will treat us, came down about 9 a.m., proved to be very friendly. Women also came along, so sure to be no fighting with them about. Brought native foods, all very excited over us and did a lot of crying over us. Bought a small pig for a tomahawk. Village of Hofrona close by, also Tinofi higher up the ridge from Hofrona. Left Hofrona 9 a.m. on May 28. Arrived Karuna 10.30 a.m. River running approximately south-west. Left Karuna next morning 8.30, am accompanied by big lines of Kanakas. Camped 10.30 a.m. Hundreds of natives around, all friendly, but very boisterous. Spent next day following the river down past several villages, followed by about 300–400 natives. All appear to be afraid of their neighbours and are never without bows and arrows. Plenty of native food to be had, sweet potatoes and sugar corn being bought for beads and small knives principally. Big ceremony in one place, appeared to be that of cutting holes in the nose and inserting bones or sticks. Weather hot in the day, very cold at night. Stayed in camp all May 31. Saw a red-skinned baby. Hundreds of natives around, all very friendly. Camped at village called Badanofera.

June 1: Left Badanofera 8 a.m. after big send-off by the entire population. Prospected for gold in the creeks, but only very small colours found. Had trouble getting from the Kanaka villages, everybody wanted us to sleep in their place. No trouble so far, in fact they are too affectionate and stink badly. They also persist in spitting on their hands and rubbing our legs, probably to show their affection of the white skin. They are also very interested in Mick Dwyer's false teeth. Camped near village called Kantik. Crossed main stream next day to the south-east side. Kanakas from Kantik accompanied us to their boundary and there was a reception committee with the next mob lined up waiting for us. No trouble to persuade them we were peaceful, so they lined up in front of us and escorted us to a suitable place to camp, bringing two pigs, which we could not buy. Plenty of native foods available. Camped about 2 p.m.

Left camp about 7 a.m. on June 3. Followed main stream on west side. Main stream now flowing pretty fast and swinging round to the south-east. Country limestone with granite. Hundreds of Kanakas about, still have stone axes here. Gardens very well laid out in straight rows, a drain between each two rows. Camped at Gavitula. Big crowd of Kanakas turned up just before dark; did not like the look of them, so doubled the watch, putting four boys on each watch of two hours each.

Left Camp No. 7 at 6.50 on June 4. Travelled south-west, crossed main stream, which is now running in a fairly steep gorge. Climbed up to the highest point of a grass range about 7000 feet above sea-level and could see a very big and apparently level valley, west from where we were. The main stream is now definitely swinging west, but may be just a local bend. The Kanakas are still with us in hundreds, in fact they lead us miles off our road in their endeavours to take us to their friends' places and induce us to camp amongst them. Very little European trade about. Big cluster of villages close to here, Sirupu. Went back to camp on the river. Left No. 8 Camp at 6.45 a.m.

next day. Crossed back over main stream by means of a bridge made of bits of bamboo and sticks tied with vines, very shaky. Travelled in a westerly direction, crossed several small streams, the bottom of a hard limestone formation. Track led through smaller basin, crossed valleys which were all cultivated; large numbers of natives living in them. Villages are all barricaded with cane-grass, bamboo, etc., and planted around for protection. There appears to be a large population in the valley, which runs back about 20 to 30 miles north-west. Most of the women have the tops of two or three of their fingers cut off as a sign of mourning for relatives killed or died. Camped 1 p.m. at the junction of this stream and another big stream coming in from the south-east. Left No. 9 Camp 7 a.m. on June 6. Crossed main stream below the junction. Went south-west. River running in deep gorge in south-westerly direction. Noticed some cave-dwellers in the side of the gorge but did not get across to them. Could not buy a pig for a tomahawk, as they did not know of them, stone being the only thing they know. Camped near village of Yemaki 2 p.m. Left No. 10 Camp 6.45 a.m. next morning. Travelled down eastern side of main stream over steep and high grass ranges. Country generally limestone. Kanakas still friendly and still produce an occasional redskin snowy-haired youngster for our inspection. They do not like to carry any cargo, smoking and betel-nut chewing appear to be unknown here. They wear a string sporran in front and a few leaves in the rear (men); the women wear long string aprons front and rear. Stone axes are the only implements they have, no pots, all cooking appears to be done on heated stones or direct in the fire. 2 p.m. a big village near, but could not get the name.

June 8: Left No. 11 Camp 7 a.m., still on east side of the river, track runs over high and steep grass ranges. Country still limestone and shaly. Dwyer went down and tried out the main stream about 800 feet below, could get colours only. The river is full of big boulders, about 2 chains wide, and pretty deep, so we have just about decided that we are not on the Ramu, but we are going to keep going, it must come out somewhere, and it's all good prospecting country once we get out of this mudstone belt. Still hundreds of natives about. Camped 2 p.m. Left No. 12 Camp 7 a.m. on June 9 with usual big escort of Kanakas, all talking at once. Climbed up to top of high grass peak, through village called Nupara, which is a big village, must be close on 7000 feet above sea-level. The houses are low round ones, the headman's being much bigger than the others and oval in shape. Passed through another village called Kiosa. All sorts of queer personal adornments still crop up, a section of dried snake being worn in the ear lobes, top joints of human finger, probably of a vanquished foe, pigs' tusks in the nose. Camped 1 p.m. opposite village of Kiosa. Left camp 7.30 a.m. on the 10th. Had a bit of fever during the night, so do not feel too good. Dropped down about 1000 feet into a big stream. Still in shaly country. Our usual escort left us when a big crowd from the village ahead appeared who took us down a grass mountain almost into the main stream, now called the Menepo. Climbed back up the mountain up to about 7000 feet and camped 3 p.m. Big river coming in from the north-west, so will have a look at it to-morrow. Kanakas call it the Maki (this stream afterwards turned out to be the junction of the Wahgi with the Menepo, which we followed down in 1934). Camped at a village called Knu.

June 11: Left No. 14 Camp 7.30 a.m. Have now left the grass-range country and entered high, timbered ranges. The river is about 2000–3000 feet below us, in a gorge as deep as any I have seen so far in New Guinea. Two fairly large streams coming in from the south-east. Climbed to the top of the high country to the village of Aurasona from where we got a good view of the course of the river, which is now running south-west. Very rough and rugged country ahead of timbered. Our food supply getting low, looks as though we shall have to turn back. Camped at Aurasona. Next day decided, after another look down the river, that it was just as easy to go on as back. Broke camp about 8 a.m. and will follow the river down and hope for the best. Went down into a big stream coming in from the east called the Wamu, which is spanned by a rickety vine suspension bridge. Took us nearly two hours to cross it, the dogs having to be put in a bag with only their heads out, and a blanket fastened to the bag and thus carried across. Climbed up the other side of the stream to village of Kubisawona. Natives were friendly and brought us plenty of native food. Camped 12 noon. Left Camp No. 16 at 7.30 a.m. on the 13th. Took us forty minutes to climb to the top of the ridge, and then straight down the other side into a small stream. Dwyer has a dose of fever, so camped at 11 a.m. close to a village called Kuravana. There is a very much worn steel tomahawk traded in from the east according to the local people. Left Kuravana 6.30 a.m. next morning. Crossed two large streams and several small ones. Camped near the village of Kaiabi. Shot a pigeon, the first since we started, so we are getting down into game country. The going is not so strenuous, the ranges are getting smaller. We have hopes of rafting down to wherever this river goes, when we get low enough—cannot cross her, she is too big. Stone axes are still very much in evidence, saw one very worn-down steel axe and steel handle of a knife sharpened were occasionally shown.

June 15: Left Kaiabi 6.45 a.m. Passed through village which was similar to others in this locality. Round houses thatched with grass and pine bark forming the sides which are about 3 to 4 feet high—they must be very suffocating from smoke, etc. No betel-nut chewing met with yet, a few smoke a pipe made from a length of bamboo with a hole and a small funnel in it, or cigarettes about 1 inch in length, pointed at one end put into the funnel and lit. Followed a long spur down to the river, which is about three chains wide and very deep—it's running like a mill-race in places and has cut deeply through the shaly country. A corpse of a Kanaka, very bloated, floated past, possibly the victim of some argument here about. Followed the river down, very rough going until we got to an outgarden of Savanna and camped, very small place in bush. Saw our first sago tree, so will be right in native food if the population come out.

Broke camp 6.30 a.m. next day. Had some trouble to get one of the Kaiabi natives to come along with us and show us a track. Eventually persuaded one to come along for a small knife. Travelled down the river, which was pretty rough going and in one place spanned by a good lawyer-vine bridge. A second body, very bloated, floated past; must be a very big population higher up. The Kanakas here are very scarce and all live in one big house. Saw a bamboo raft in the river, so may be able to use one lower down. Millions of leeches about. Camped in the bush.

Left camp 7 a.m. on the 17th. Native foods very scarce. Followed down river, now called the Tua, crossed a big stream coming in from the east. River now very big. Saw the remains of natives thrown up on the beach, also a raft; will be glad when we can raft down, as my boots are just about gone and there are millions of leeches eating the boys and dogs and ourselves. Climbed up out of the river and travelled south until we came to a village called Tunawona. Only about twenty or thirty people here. Camped in Tunawona.

June 18: Left Tunawona 7.15 a.m. next day. Got a few natives to accompany us and show us the track. Travelled south or south-west from the village through level, heavily timbered forest country. Track very boggy; crossed several streams including one fairly large one which was down about 400 feet below the level of the terrace. Camped at 3 p.m. at a place called Para, a small village in the bush. They still have stone axes and wear feathers in their noses, have no rear covering, very little in front, and greet you with the word "Abu." Left Para 6.45 a.m. next morning. Got a few Kanakas to accompany us and carry some of the cargo; they do this for a narrow strip of red calico. There is not much cargo left, but it is best to conserve the boys' strength in case we run out of native food later on. Natives were very friendly and have no trade with the exception of very much used tomahawk here and there. Camped at Karubwani 3 p.m.

Left Karubwani 6.45 a.m. on the 20th. Mosquitoes were bad during the night, so will have to use nets from now on. Travelled approximately south over about the worst mudhole of a path I was ever on. Crossed over small streams, country limestone. About 2 p.m. came to a look-out in the range, can see nothing but mountains in the direction we are going. Have not seen the river to-day, but the Kanakas say that we were going parallel with it and will strike it in the morning, and will be able to raft down it after being joined by another named the Piu. Camped at small village called Piu 3 p.m. The people appear to live on sago only, some of which we bought for the boys. Left Piu 7 a.m., crossed stream called Nami and thence due east over limestone country. Travelled approximately south over limestone boulders. Reached a small Kanaka house about 11.30 and had lunch. Camped on a big stream called the Piu, cannot cross it to-day, local natives also cannot cross. Camped on the river.

June 22: Rain very heavy all night and at 9 o'clock at night boy had a look at the river and said there was a big flood coming down. Had to get out in the rain and make a new camp on higher ground. Found a small patch of sago trees. Going to be difficult to cross the river. Got the Kanakas to fasten some sticks together, pig-sty fashion, covered this with one of the flys—it made a good flat-bottomed punt—about 5 feet wide and 7 feet long, and will endeavour to pull it backwards and forwards loaded with cargo and boys by means of lawyer-cane ropes held by boys at either side; but after several attempts by boys swimming with a line and trying to cross with the punt we could not get a line over to ferry across, the current being too strong, and every time it bore the boys down the stream when they endeavoured to take it across. Without a line aboard it is too risky, as the river runs over a series of rapids about 300 or 400 yards below here, which would smash it up. Camped

another night. The river again came down in flood during the night; tried to get a rope across it but with no success. Our food is just about finished, living principally on sago. The boys cut out a small out-rigger canoe and we had great expectations waiting to try it out, thinking that we would be able to camp on the other side to-night. However when we tried it out it was too small and the log too green to support more than just one boy.

On the 24th we gave up the idea of the punt, and started the boys on cutting out a big canoe. Shot a few pigeons, so have pigeons and sago to eat. Some of the boys cutting sago for themselves and our consumption. Cut a track up to where the boys were making the canoe. The canoe is about 15 feet long and almost 2 feet through: got it down to the river about 1.30 and put the out-rigger and platform on, cut three poles, tried it out about 3 p.m. Three boys tried to go straight across the current, but were swept down and landed in a back-wash. Endeavoured to row up opposite side in order to cut across back, but the current was again too strong, so one has to pull it along the bank while the other sits in. Next trip four boys went over, but with the current to the back-wash. Some will sleep on the other side to-night and we will get the rest over in the morning, all being well. Dwyer has a dose of fever and does not look too good.

June 26: No rain last night, so river is reasonably calm this morning. The six boys who slept on the other side got the canoe into the water about 6.30 a.m. Got all the gear and boys over by 10 a.m., climbed up the ridge and found an old track leading up: followed this principally through broken shrub. Found a Kanaka house in the making, two-storey house built in the top of trees, the top floor about 30 feet off the ground, 40 feet wide, and 150 feet long, with a good roof. Camped here. Boys saw two natives, but they ran away. Decided to camp at this house next day and work the sago tree nearby, as there is no other native food about. Took about a day to work this, which should be sufficient to keep our line going for three days. The Tua river is close by, running south-east-by-south but running due south after being joined by the Piu. Have a boy with a gun stationed on all roads here and will get in touch with the natives and give us the alarm if they are hostile. On last of our flour, can make another loaf; if we could only get on to some taro it would not be so bad—boys finished the sago to-day, reckoned they have enough for two or three days. One of the boys saw a big blue pigeon which does not get high above sea-level, so we must be getting down somewhere; also saw the shell of a coconut probably traded by the river. We also found the bottom of a glass bottle, which therefore indicates that we are getting near civilization.

Left in the rain at 6.30 a.m. on the 28th, and followed path down towards the river; heard Kanakas beating a drum of some sort and one yelling. Reached a big house alongside the path about mid-day. Saw some Kanakas coming on a raft down the river, which is now about 5 chains wide and heaven only knows how deep, and travelling at a fair rate. We think it may now be safe to make a raft and float down: very difficult to find a track running parallel to the river, so have to cut our way. Natives here use no outrigger on their canoes, just a log hollowed out to about half an inch thick. Reached another big house about 3 p.m., so decided to camp. Found a fire, still hot, in the house, indicating that the Kanakas must have heard us coming and ran away. An

empty meat tin suggests we are not too far from civilization. Broke camp 6.30 a.m. next morning and cut our way parallel along with the river, saw some Kanakas in a canoe on the other side of the river, but immediately we called out to them they ran away and appeared to be very frightened of us. Continued until 2.30 and camped in an old house. Only travelled 5 miles all day on account of the rough going.

June 30: Decided last night that this river looked all right and would make a raft this morning, but decided to investigate a rumble we heard last night coming from lower down the river and found that the river about two or three hours from the camp runs through deep limestone gorge and over a series of rapids which would certainly have smashed up any raft we could have made. Could not get through the gorge, steep limestone cliffs on either side about 1000 feet above us, so have to turn back and camp at our previous camp. One of our dogs was killed crossing one of the limestone cliffs, a big boulder rolling on him. Cut down and worked on a sago tree next day. During the afternoon natives from the other side intimated they wished to come across and show us the road out, and two came over in their canoes, very frightened. Gave them a present and they promised to come back in the morning and show us the road out. Two of them came along to show us the road, went about three hours back along our track and then over the range. They then pointed out the river below after it had come out of the gorge. They intimated they wanted a drink, and slipped away into the bush. Found a track down to the river, which is still running in a limestone gorge, but possible to get along it. The path was almost straight up the face of the cliff, and in one part we had to climb up a tree, then on to the path again, but got over. On the other side of this ridge the river is now running steady again and the mountains appear to be about finished. Continued on down the river until 4.15 and camped. Rained all the evening. The boys saw a Kanaka house on the opposite side, also heard voices, so we may see them in the morning.

Started off at 7.15 a.m. on July 3, got down about a quarter of a mile and shouted to a Kanaka on the other bank, but could not induce him to show us a track: they are very frightened. The river is wide here, about 300 yards, and travelling fast, but possible to raft. The mountains have given way to low hills and level stretches of country heavily timbered with thick undergrowth, but we will go on by foot for a day or so longer to see if we are really in good water and we are sure we are out of the mountains and gorges. Saw a Guyrie pigeon, which is a sure sign that we are in low flat country. Camped 3.15 p.m. Left camp at 6.15 a.m. next day and cut our track parallel with the river through thick scrub. The river spreads out wide here. Seen some natives (about 10 a.m.) whom we persuaded to come over in their canoes after a lot of talk; they are very frightened of us tying up their hands. Eventually purchased a large canoe from them for a large knife—got the boys to put an outrigger on it and will try to carry the cargo on it with Dwyer or myself, and the other walking on the bank. We will find a place where there is some sago and cut two big ones of our own. Crossed the river by means of the canoe, taking the cargo and boys. Dwyer, who has developed a bad boil, some of the boys, and all the cargo travelled on the canoe, while myself and the rest of the boys cut our way along the bank parallel with the river. Found a small

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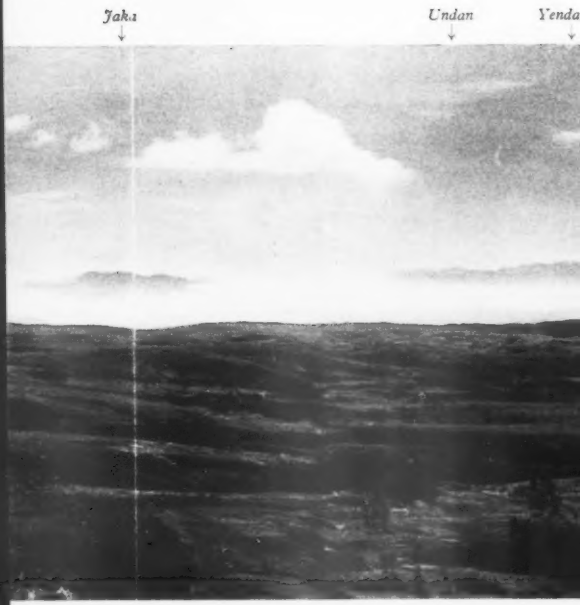


Looking down the Wahgi valley from the ne

Looking E.N.E. from Ke

Yendaiwa

rom the neighbourhood of Piuada

Nang Kil

Kubor

from Keluwere

Nang Kil

Looking W. from above Pubu

The valley of the Markham River, from the neighbourhood of Onga

Kanaka village after two hours' hard work cutting our way through the bush. We bought three fair-sized canoes from them for a few large and small knives, and the boys are now busy putting outriggers on them in preparation for an early start in the morning. We are now living on pigeons and sago, saving our few tins of native food for a bad time.

July 6: Left at 5.30 a.m. in our fleet of four canoes, two lashed together, while the two others have outriggers on them. Dwyer and five boys went in one, four boys in the other, while seven boys and myself went in the double one. Travelled very fast down the stream—seeing a meeting of two big hills, we imagined another gorge was about to turn up. However the river just flowed on through level country. We feel pretty sure now that we will be able to canoe right down to the mouth of the river. Passed two big streams coming in from both sides. Drifting along about 10 miles per hour. Camped 3 p.m. on the side of a bank; millions of flying foxes about; raining most of the time. Got away at 5.30 a.m. next day. Saw some Kanakas with calico *lap-laps* and leather belts on, could not talk pidgin although one said "yes" a few times; don't know whether he knew the meaning or not. Bought sago off them for some small knives. Had lunch at a native house at 11 a.m. and saw two natives, one of whom eventually came over and addressed Dwyer and myself as Taubada, which sounds like Motuan, so there may be just a possibility that we are in Papua. Got a few taro and yams off him. Saw plenty of alligators. Camped on side of river, got away at 5.15 a.m. in good weather but a bit on the cold side. The river showed a slight rise. Came to several young coconut trees, but can see no sign yet of any village. Struck a few more Kanakas, who sold us some sago, one had a singlet and, according to a Waria boy I have, he also spoke Motuan. We could get no information regarding where we were, but it must be Papua. Sago swamps beginning to appear, which means millions of mosquitoes. Camped 3 p.m. close to a native house where a sick native was. During the evening three canoes full of Kanakas came over, nearly all had *lap-laps* on and some could count up to ten and spoke what we think was Motuan, the language of Papua.

Got away 6 a.m. on July 9 and crossed over the river to some Kanakas who had promised to give us some native food. Nearly all have calico and some singlets on—one spoke a few words of pidgin: told us a policeman was one day away and a magistrate five days—all very friendly and evidently under control for some time. Dwyer is now in my canoe, since we are out of hostile country, and there is no need to have a white man in the boys' canoe.

The country is now very low, the river banks being mostly sago, with light scrub, and it all appears to be under water a lot. Camped about 3 p.m. Some natives nearby told us we are in Papua and that a magistrate was to be found at Tormille, also a store, and he promised to show us the way, which is down a side stream, which he says takes four days to reach the sea. Got away at 7 a.m. next day and about ten natives came along in two canoes. Took us down a main stream and at about 12 noon came in sight of a group of buildings, also a smoke stack and stacks of timber, and it turned out to be Port Romilly Sawmill, managed by Mr. C. McKinnon, who made us very welcome and gave us an invitation to stop as long as we wished. He advised us that a boat had just left the day before for Port Moresby, but there is another due in

twelve or fourteen days' time. The nearest magistrate is about 60 miles away, and I may get up and see him over the week-end, going up on the punt with a load of timber. We have come right across the island and have definitely discovered where the Purari River rises, and will now have to go on to Port Moresby to get back to Salamaua.

July 19: With Mr. C. McKinnon and Dwyer and our line of boys went on to Kikori, where we met the Resident Magistrate, Mr. L. Austin, and Mr. C. Champion.

August 9: Got away from Kikori on board the *Papuan Chief*. We arrived Port Moresby on August 15 and left on the 21st, to walk back overland to Morobe, reaching there on Wednesday September 3. We finally arrived in Salamaua at 12 o'clock on September 7.

SECOND JOURNEY, October–November 1930

From Salamaua up the Markham Valley, down the Ramu Valley to Gaitluren, thence over the Bismarck Range, down the Dunantina and Kamamentina rivers near to the village of Gavitula. North-west from here over the Bina Bina and up the Gafuku Valley which has never before been visited by white men. Over the Bismarck Range on the western side of Mount Helwig, down into the Ramu valley, south-west of Madang. Thence back up the Ramu Valley down the Markham River to Salamaua River.

October 3: Left Salamaua river by launch with Mr. M. I. Dwyer and sixteen native carriers. Arrived at Lae 7 p.m. Left Lae Saturday, October 4, at 7.40 a.m. Followed up the Markham valley to Lagitsuman, arriving here on Thursday, October 9. Left Lagitsuman Friday, October 10, and went into the headwaters of the Ramu to Onapinka, where Mr. Ned Rowlands was working some alluvial gold. Returned to Lagitsuman on Thursday October 16, and proceeded on to Gaitluren on the Ramu River, arriving there on Saturday, October 18. Crossed over Bismarck Range into the head waters of the Dunantina River. Followed this down to a village called Yatnofi. Turned south and crossed over the divide into the Kamamentina River. Followed up the Kamamentina river to a village called Tebinofera, which is north of Munifinka, and on Friday, October 31, came back down the river about 3 miles. Camped.

November 1: Crossed over divide 7500 feet above sea-level and dropped down into the Gafatina. Followed this down to its junction with the Kamamentina.

November 3: Camped on the Dunantina near Gavitula near where we camped on our first trip a few months ago. Followed a north-westerly direction over grass ranges and small valleys not very thickly populated. Arrived at a large stream called the Bina Bina about 1 p.m. and camped in a village on the banks called Korofagu. Very big population here and, as we afterwards learned, cannibals. A big valley running away to the north-west of us, principally flat terraces of alluvial cut through by streams coming in from the ranges on either side and populated by many thousands of people all armed with bows and arrows. No steel of any description here, all using stone axes. Left Korofagu 8 a.m. on November 5. Followed north-west parallel with the

Gafuku river, which appears to be the main stream draining the valley to the north-west. Hundreds of people accompanied us along the road. Very frightened at the start but friendly later on. Camped at 12 noon near the village of Assami.

November 7: Got away from Assami, 5300 feet above sea-level, about 8 a.m. Up and down over the gullies worn by streams cutting through the alluvial beds. Met hundreds of natives. Camped near the Gafuku at a village called Ontunu, the village of Asenu being close by. The Gafuku is a bigger stream than the Bina Bina, which it joins farther to the east and both together run into the Purari. Broke camp 6 a.m. 5000 feet next day. Travelled north-west up the valley and camping again near the main stream. Got away 6 a.m. across the valley towards the Bismarck Range through very thickly populated areas. Crossed the Bismarck Range 7000 feet and camped on the Ramu Fall in a small village at 4 p.m. Broke camp at 6 a.m. on November 10. Followed a stream down the side of the mountain, very rough going, to a small village where we camped at 2 p.m. Broke camp at 6 a.m. next morning. Up and down mountain spurs until 3 p.m. Camped in a village called Awni. Very few people here. The Ramu valley is about 1000 feet below us and is very thickly timbered—small patches of grass here and there.

November 12: Broke camp 6 a.m. and got down on to the Ramu valley about 600 feet above sea-level. Crossed the Ramu in native dug-out canoes and camped near a village called Onubi, one of the natives of which can speak a little pidgin English. Here we are in semi-civilized country and following back up the Ramu Valley and down the Markham Valley arrived at Salamaua on November 28.

THIRD JOURNEY, March–April 1931

In March 1931 an expedition was financed by the New Guinea Goldfields Company of Wau, into the country south-west from the Upper Watut Aerodrome over the Papuan watershed to the Kapau River, explored in 1929 by Mr. H. Baum, who has since been killed by the Kukukukas who inhabit the thickly timbered ranges along the centre of New Guinea as far west as the Purari River. Thence east, cutting the headwaters of the streams running into the Fauri River and through sections not having been travelled over before. Thence along Patrol Officer Hides' route back to the Watut River.

Made two reconnaissance flights from the Upper Watut Aerodrome with the late Mr. Les Trist of Guinea Airways, Ltd., in a Gipsy Moth, south-west over the Papuan dividing range, north-west over the headwaters of the Langima River. Thence back to the aerodrome. From the air the country to the south-west looked to be mainly heavily timbered, broken ranges with here and there a group of native gardens nestling on the slopes of the ranges. Over the Langima and to the south-west the country is steep grass ranges, and numerous villages gave promise of native population, which meant food for the line of native carriers we would have with us carrying our stores, etc. Left the Upper Watut Aerodrome on Wednesday 25 March 1931 with my brother, Mr. P. Leahy, and Mr. M. I. Dwyer, accompanied by eighteen natives to carry our equipment, etc. Followed up Surprise CK. on the north

side, then crossed over the headwaters of the Waiganda, camping at 12.15 p.m. near the village of Ekuti, 6300 feet.

March 26: Broke camp 7 a.m. Travelled south-west through bush country; camped 2 p.m. near the village of Dijambi, 5200 feet. Crossed over the range and into the Papuan Fall, 7000 feet, and followed down a timber spur to a stream running south and camped 2 p.m., 3700 feet. Stayed here until Monday March 30 prospecting the streams nearby and pushed on south-west through very broken timbered spurs, running almost due north and south, camping at 1 p.m., 3000 feet, near a large stream running south.

March 31: Steeple-chased over 500-foot timbered ranges, crossing another large stream running south. Continued on to a stream too large for us to ford, 3350 feet. Here we found a small group of natives (Kukukukas) farther to the west. The grass ranges ahead gave promise of a large population, but we could not see too far. Camped at 3350 feet. Turned back next day east-north-east into the timbered ranges, cutting our way for the most part, crossing several large streams coming off the main dividing range to the north of us, finding a few villages inhabited by Kukukukas, who were very shy and for the most part avoided us. The country was principally heavily timbered ranges running at right angles to our track. On Wednesday April 8 we found one of Baum's camps which he had used a day or so earlier on his way down south of Edie Creek. Followed his route back over the dividing range, the highest point being 7800 feet, and arrived at the Upper Watut Aerodrome on Saturday April 11, at 5 p.m.

FOURTH JOURNEY, April–May 1931

Approximately north-west of the Upper Watut Aerodrome across the headwaters of the Langima River, down into the Papuan watershed, thence back down the Langima River to the Watut to the Markham, down the Markham to the coast at Lae.

April 23: Left Upper Watut aerodrome 8.15 a.m., 2000 feet above sea-level, with my brother, Mr. P. Leahy, and fourteen native carriers. Camped west of the Watut aerodrome at 3.15 p.m. at 5000 feet above sea-level. Broke camp 7 a.m. next day. Travelled approximately north-west, dropped down to 4500 feet and climbed up to 6700 feet through heavily timbered country. Very few natives. Camped at 2 p.m. 6400 feet near a Kukukukas village. Very little native foods. Broke camp at 7 a.m. on the 25th. Dropped down 1500 feet into a stream where all signs of native tracks were lost. Continued down the creek, but could not pick up another track, so cut our way approximately west up on to a ridge 5000 feet above sea-level, where from the top of a tree which one of the boys had climbed to see if he could see if there was any habitation, he picked out a native garden at which we arrived three hours later and obtained some native foods for the boys.

April 26: Broke camp, cutting our way west. Camped in the bush 3 p.m., 4725 feet above sea-level. Cut our way through heavily timbered ranges. Followed down a stream and found a native track running approximately north-west parallel with the creek which disappeared to the north, so cut our way to the west until 2.30, when we came out on to a grass ridge. Camped at

3900 feet above sea-level. No natives. Left camp 6 a.m. on April 28. Climbed up the timbered range to 5000 feet, at the top of which we had seen a village about south-west from here through a gorge. Arrived there three hours later. The village was practically deserted, but the few people there supplied us with native food. From here we could see the Markham valley to the north. The country is now generally grass ranges. We were delayed here April 29–30 on account of bad weather, the heavy fog preventing our being able to pick out native gardens where we could get food for the boys.

May 1: Weather being clear, we got away at 6.30 a.m. Travelled approximately south-west for about 4 miles up and down grass ranges. Could make out a village about a day's march away on top of a grass range. Camped 3 p.m. Broke camp 6.30 a.m. next morning. Followed down the grass ranges and had lunch near a village, the inhabitants of which were very hostile and opened fire on us with arrows. We were forced to fire on them in return and killed one, which stopped the fight. Camped amongst them and made friends.

May 3: Crossed over a grassy spur and dropped down into the main headwaters of the Langima River. Mostly a conglomerate country and camped on the river. Natives now very friendly and brought along plenty of native food which we bought for beads and small knives. Crossed main stream and followed it up for about 3 miles. Fairly big population about here and all appear to be friendly. Camped alongside the river at 10 a.m. and prospected it.

Broke camp at 6.30 a.m. on May 5. Climbed up on to a grass spur 5800 feet above sea-level. Followed this in a westerly direction for three hours, dropping down to 4500 feet into a small tributary, running through a patch of grass country. Carried on north-west into bushy country, following a fairly wide native road, going round a spur and down into a creek on the Papuan watershed where we camped. During the evening saw two natives from a village which must be on top of a range to the west of us, but could not get in touch with them. Surrounded and attacked by a mob of Kukukukas just before daylight. Succeeded in driving them off after killing six of them, my brother Pat getting an arrow through his left arm and another one in his right lung, and I being knocked out by a blow on the head with a pineapple club and an arrow which grazed my cheekbone. Two of our boys also sustained injuries, one getting an arrow through his knee and another an arrow through his right side.

May 6: Decided on account of the wounds that it would be best to get back to the coast and see a doctor as soon as we could, so climbed back on to the top of the range, 6000 feet above sea-level, having to dump some of our cargo in order to carry my brother, who was suffering from the effects of the wound in the lung. Camped at 4 p.m. in the bush. Went on down into the Langima over very rough country. Camped near a native village at 2.30 p.m. 2600 feet above sea-level. Natives here brought us food. Left camp 6.15 a.m. on the 8th, after a very bad night. Pat being much better, he decided to try to walk. Followed down the river, cutting our way through the patches of scrub, and camped alongside the river at 9 p.m. 1900 feet above sea-level. Broke camp 5.15 a.m. next day, following down the river over very rough conglomerate country, reaching the civilized village of Sankaf at 5 p.m. 925 feet above sea-level.

May 10: Followed down the Langima to the Watut junction and camped at Sodenz at 4.30 p.m., where we met Mr. Samson, a patrol officer, who had two rafts constructed by the local natives, and on Tuesday, May 12, we started to raft down the Watut and Markham rivers, reaching Lae two days later, where we saw a doctor who attended to us.

FIFTH JOURNEY, October 1932–July 1933: Marifutiga River to Mount Hagen.

From the Marifutiga River, which was our farthermost point west in February last, to Mount Hagen, the weapons of the native population gradually changed from bow-and-arrow people to a mixture of bows, arrows, and four-pronged spears (the three smaller prongs being located about 3 inches from the main point), battle-axes, and spears mainly were used. They were a much bigger people physically (some being up to 6 feet tall) than the Bina Bina or Ramu people back east. From around the waist on a bark belt some 6 to 10 inches wide was suspended their back covering of leaves, also the front covering which reached to their toes and was up to 1 foot wide. Their big mops of hair were bound up tightly in bark cloth as a protection against a blow on the head from a battle-axe, and most of them were bearded. They are undoubtedly the best specimen of native I have yet seen in New Guinea. The women showed amazing confidence in their menfolk and at times, when a fight seemed imminent (they could not understand our walking in on them, and being naturally suspicious, endeavoured to prevent our marching through their country) they never attempted to run away. Net bags are not worn by all the women in this area (baskets woven from the outer skin of cane grass being used) until in the vicinity of Mount Hagen, when baskets disappeared and a wide-meshed net bag again was worn suspended from their heads; a long strip of strong string about 4 to 6 inches wide, a small fringe of shorter strands on either side of the main covering forming the front covering, and a narrow fringe of string formed their back covering. The front and back coverings reached below the knees, and a wide-meshed net bag made out of thick string suspended from the head, down the back, reaching almost to the knees, again became general.

Their method of gardening from the vicinity of the Chimbu River is totally different from that farther east. Symmetrically perfect draught-board shaped garden plots, 7 to 10 feet long, 10 to 15 feet wide was the method used. This peculiar form of cultivation we found out was due to the wet nature of the country, the garden beds being first lined out by means of long lengths of vine pegged out along the ground, then long, sharpened oar-shaped lengths of wood were used to dig out a channel 18 inches wide by 1 foot to 6 feet deep, depending on whether the area was very wet or otherwise. The ground dug out of the channel which was all good surface soil is thrown on top of the beds, broken up by the women with sticks and their slips of sweet potatoes, etc., planted in it. In the vicinity of Mount Hagen rounded beds up to 10 feet in diameter are used in place of the square or oblong-shaped plots, the rounded beds allowing for better drainage. In all the headwaters of the Purari River the natives who, owing to inter-tribal wars dare not go to

the timber-covered ranges in the vicinity to get timber for building purposes, firewood, etc., plant casuarina trees, a quick-growing, easily split hardwood, and in the Bina Bina, Gafuku, and Wahgi river valleys which are much wider and almost all grass country, are to be found thousands of these artificially planted trees, and when the owners are unfortunate enough to be driven out of their villages the invaders do not consider that they have destroyed the village properly until they have ring-barked every tree and so destroyed it. They would cut them down but for the fact that it would be too long and hard a job with their stone axes.

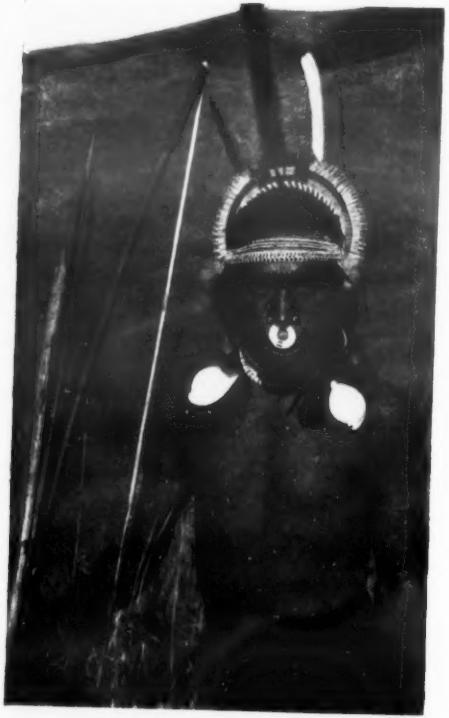
From the Chimbu onwards the houses of the natives change. The houses are still oval in shape but not quite as wide or big as those to be found farther east, and they are not grouped together in villages, but are mostly in small groups up to three, surrounded by their fenced-in gardens of bananas, sugar canes, beans, etc., their pigs tied to stakes in the ground by a rope attached to their front legs being always in evidence.

Near Mount Hagen we found the centre of a decorative and highly developed system of ceremonial grounds. These are small areas of ground up to 5 or 6 chains long to 2 chains wide, levelled off by digging away any high portions with their pointed sticks and building up the low portions with the dug-out earth. The area is then planted with grass to form a lawn. Down the centre in a straight line at intervals of 20 feet, split slabs bound together up to 3 feet above the ground and filled with earth are placed, and ornamental shrubs, brightly coloured plants, native flowers, etc., are planted in and around these. Down each side of the lawn ornamental shrubs, flowers, and casuarinas are planted, and leading up to the lawns and from every direction for a distance of half a mile, pathways up to 4 feet wide over which ornamental trees and shrubs are planted on either side and meet overhead; these form a pleasant walk to the ceremonial ground, and keep the villagers from walking on the grass when no feast or ceremonies are in progress. At one end there is usually a hollowed-out area up to 3 to 4 feet deep and 15 to 20 feet in diameter in which a grass-thatched house is built, open on the side nearest the ground for 8 feet by 3 feet; here is stored, during the feast only, the gold-lip shells and treasures, etc., of the people who congregate in thousands to march around, and display their wealth, or for the elders to sit in and warm their old bones alongside a fire, contemplating the feast of pig of which they are about to partake when the lines of pigs, tied to sharpened sticks, driven into the lawn in perfectly straight rows down the full length and farther of the ceremonial ground, are killed; their carcases are cooked in holes in the ground with hot stone and the well-cooked, very appetizing meal is dished up to them, garnished with sweet potatoes, bananas, native cabbage, etc., and eaten to the accompaniment of hundreds of men and women arrayed in their barbaric finery, their arms and hands locked together, dancing around in circles, lustily singing their very musical songs.

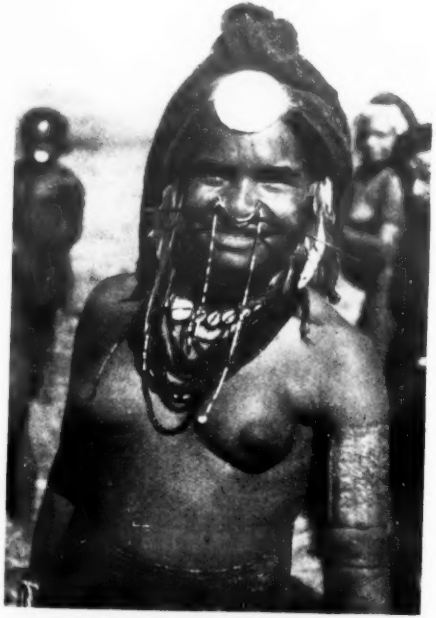
In October 1932 Mr. Harrison, the General Manager for the New Guinea Goldfields Company operating in the Morobe District, asked me to take in their geologist, Mr. Kingsbury, to the Purari headwaters and show him the auriferous areas we had found in 1930. My brother Dan and myself with our

line of natives left Salamaua on Tuesday 25 October 1932 and walked up the Markham Valley over the range into the headwaters of the Ramu River where a temporary aerodrome had been made, arriving there on Thursday November 3, and waited until Mr. Kingsbury and Mr. R. White, his assistant, came in by aeroplane from Wau. Getting away from the Ramu aerodrome on Monday November 7 we crossed over the 6500 ft. divide into the Purari headwaters and followed the Kamamentina down to the Dunantina, camping in Gavitula village on Sunday, November 13. Leaving there on Tuesday the 15th we went north, crossed a grass divide 7100 feet into the Bina Bina Fall and travelled down the Bina Bina River to Gawritufa Creek, where we found traces of gold in the creek gravel. Camped near the village of Korofagu on the Bina Bina River on Sunday the 20th, where an axe was pulled off one of our boys by a local native They would not give it back, and knowing that one successful theft is always followed by another and if not stopped leads to a fight, we, loath to use force to recover it, decided to move our camp which we had erected in amongst clumps of bamboos, which afforded cover for them in the event of an attack, to the top of a nearby grassy ridge, where we got a good view of the approaches to the camp, and so would be able to prevent a surprise attack during the night. However they had already made up their minds that we were afraid of them, and not knowing firearms, also imagined that we were unprotected, and when they saw the camp being pulled down and packed up, attacked us on the outskirts of the village. We stampeded them with a volley, four of them being killed. Pushed on down the Bina Bina and camped on the junction of the Gawritufa and Bina Bina. The next day we turned east, and on Tuesday, the 22nd, camped near Sirupu village. Here a native named Namu, whom I had seen in 1930 and who recognized me again, decided he would like to come along with me, have a look where we came from and then come back and tell his friends all about it. His relatives did not want him to go, but he was determined to come along, but we had a very anxious time until we reached the Ramu 'drome on Friday November 25; all the people along the road, thinking we were taking him away to eat him, tried to rescue him. Mr. Kingsbury and White went back to Wau by plane, and we sent Namu out by the next plane in charge of Pilot Mr. R. Gurney to show him the sea and some of the, to him, wonders of the white man. He came back next day in the plane with two bottles of sea water (salt being valuable trade in his village), a handful of hairs out of a horse's tail, to prove to his friends that the white man has big pigs which a man can sit on top of, a collection of coloured cloth, axe, knives, empty tins, etc.

Dan and I having decided to go back to Gawritufa Creek and make a base camp and aerodrome there, further prospect Gawritufa Creek and explore the country in the vicinity, on Tuesday December 6, with Namu out in front displaying his goods and telling all that we were O.K., we started back to the Bina Bina River. Leaving Namu in his village, by now the most important and knowledgeable young man in the district, we arrived at Gawritufa Creek on Thursday December 15, after having done a circle above the 6000-foot level of all the tributaries running into the Bina Bina in the hope of finding the stream which was bringing the gold down into the Bina Bina and Gawritufa Creeks. By the time we got to our proposed base camp our line of natives had



Bina Bina man



A Middle Wahgi woman

Hagen man

Sing-sing ground, Hagen

A village above the lower Wahgi gorge

increased to fifty; several from each village we passed through after seeing Namu returning safely with lots of trade goods also wanted to walk around with us and be taken back to Ramu and to go to the coast in a plane. They now have the utmost confidence in us.

On Saturday, December 17, Mr. J. L. Taylor, an A.D.O. in the administrative service, arrived at our base on Gawritufa Creek following directions with which I had supplied him before leaving the Ramu. He went back to the Ramu the next day, Sunday the 18th, not being able to stay any longer on account of trouble amongst the Ramu natives. He left us thirteen natives to assist us in building the aerodrome, which was on a flat-topped grass ridge 5000 feet above sea-level. The surface badly scarred by old native gardens. Got a line of local natives to assist and in a week with over one hundred natives, including our thirty boys working on it, it was ready for a plane to land on it. On Christmas Day Mr. Bob Gurney, in a Gipsy Moth plane with Mr. Taylor a passenger, landed the first plane on it and took off O.K. Our communication with civilization was opened up and the first base camp established for expeditions into the country to the west and out to the Sepik River, a project always in the back of our minds. Prospecting around our base we found sufficient prospects for Major Harrison, New Guinea Goldfields Co., to again send in some of his staff to examine, and on Saturday, 11 February 1933, with Dan, Mr. Marshall, and our line of boys, we left the base to do a trip down into the country south-west over the Gafuku divide, which was all new country and never before visited by white men.

February 11: Camped Mahometofi. Broke camp 7 a.m. accompanied by several of the local natives who wished to have a look around their country under our protection, crossed the Gafuku and camped near Yabetufa. Climbed up a grass range and camped 7800 feet on top of a grass knoll, escorted all day by hundreds of natives. Big population living on the broken grass ranges to the south and west. While the villagers were around our roped-off camping area, natives from an enemy village nearby crept into the village near our camp and shot an arrow through an old man who was too feeble to walk up to look at our camp; they fired a house and got away before the locals could stop them. The 14th was a clear morning and we caught sight of a high mountain peak almost due west from our camp, which later we found out was Kubor, 14,300 feet, on the range between the Wahgi and Nabilya rivers. We broke camp and followed down a grass spur, steeple-chased over 1000-foot grass ranges, and camped near the village of Nuku. Left camp 8 a.m., turned approximately west, followed by hundreds of natives, many leading pigs along tied by the foot asking us to buy them. Climbed up to a grass range. Followed this up into the timber country to 7500 feet, where from a cleared look-out we saw in the distance the huge valley to the west-north-west of us which we now know as the Wahgi (the end of the valley lost in a blue haze from grass fires suggesting that the large native population through which we were passing continued right on the west and north-west of us). So made a trip to the Sepik River reasonably certain of accomplishment, populated areas where one can obtain native foods for one's line of carriers, etc., being a necessity once the coast or navigable rivers are left behind. Dropped down off the spur

passing through a big village and were greeted by the villagers shouting "Wenduli!" The inhabitants, seeing our boys and ourselves with what they thought were just sticks on our shoulders, put their bows and arrows down and picked up lengths of wood and marched along with them on their shoulders. Crossed over a limestone divide into the Marifutiga River fall, camping amongst a large population under Irimbadi. Here we saw the first battle-axe blade. My diary says, "There is also a flat stone tomahawk here which I have never seen before in shape or thickness. It's a work of art." We later found the centre of this trade higher up the Wahgi River. The natives, their houses, gardens, weapons, etc., are similar to those found in 1930 below the junction of the Gafuku and Purari and three days into the bush country south of the Wahgi–Purari Junction, with the exception of a few wide bark belts worn, and a custom of tattooing the faces and backs of both men and women. The younger women in this area wear more decorations, bright-coloured birds' feathers in the nose, pieces of green snail shell and necklaces of the common sea shell around the neck. They are a very immoral people, and the younger and apparently unmarried girls spent most of their time around our roped-off camping area offering themselves to our boys for a few shells, their men assisting by endeavouring to assure them in sign language that it was O.K. with them. On this trip we brought back to our base at Bina Bina five of the stone battle-axe blades, and also saw a green stone working axe traded down from the Wahgi River west from here; the centre of this trade we found later on when on our way to Mount Hagen.

February 16: Left camp 7.30 a.m.: big crowd of natives accompanied us. Tried to cross the Marifutiga River, but it was running very fast, so could not do so; turned north-east, followed up the river, hundreds of natives yelling "Wenduli" as we passed through their villages.

February 17: Crossed the main north-east branch of the Marifutiga River, climbed up a grass range to a village 8500 feet and camped amongst the Onu people, many of whom stood outside our rope through a hailstorm, holding a banana leaf over their heads and appeared not to notice the intense cold which we were feeling. Broke camp 7.10 a.m. next day, steeplechased over thickly populated cultivated ranges, then followed a track through bush country up to 9100 feet, dropping down to the Gafuku River, passing through hundreds of people and camped on the Gafuku River near where Dwyer and I camped in 1930 on our second trip into the Purari headwaters, some of the local natives again recognizing me and one or two of our boys who were still with me.

Pushed on down the Gafuku River towards the base camp, meeting A.D.O. J. L. Taylor, who had come in again from the Ramu area, and was looking around preparatory to putting a post in on our aerodrome at Bina Bina. Told him about the huge new valley we had discovered and that I was going into Wau to arrange with Major Harrison to send us on into the country to prospect it; reached Bina Bina base camp Monday February 20.

February 27: Went in by plane to Wau to report to Major Harrison and also tell him about the new valley we had looked into; he was very keen about it and decided to fly back to our base at Bina Bina and then charter a Guinea Airway Junker plane and go for a fly out over it, arriving back at Bina Bina on Monday March 6.

March 8: Major Harrison, my two brothers, Dan and Jim, and I, flew out with Mr. Grabosky in a Junker plane west and north-west, and looked down into the Wahgi Valley. Back at the base camp Major Harrison was very enthusiastic about our discovery, and we made preparations to go in and explore it, making aerodromes on the flat grassy areas we had seen from the air and by a system of smoke fires, signalling planes, coming in on a day and direction arranged before leaving the base, whether the ground was suitable to land on or otherwise.

March 28: After another reconnaissance flight out over the Wahgi Valley with Mr. J. L. Taylor, Mr. Ken Spinks, my brother Dan, and Mr. T. O'Day in a D.H. 50 aeroplane. We left the base camp at Bina Bina with my brother Dan, Mr. K. Spinks, and sixty carriers accompanied by A.D.O. Mr. J. L. Taylor and a line of native carriers and police boys, the administration acting on information supplied by me, having decided to send a patrol party in with us; also to look over the new valley we had discovered. Crossed over the range into the Marifutiga River, reaching our camp of Wednesday February 16 on Friday March 31. From here on we were in new country.

April 1: Broke camp 8 a.m. Travelled along the foot of a limestone wall which rose up sheer for 1000 feet above, over thickly populated ranges, and camped among the Mogu people, who all yelled "Wenduli" in greeting; plenty of native foods, thousands around camp. Broke camp 7.20 next morning followed by hundreds of natives. Passed over a low grass divide 6700 feet and through a big village, the people of whom greeted us with "Sheone" and "Wenduli." Camped near the Kumukul people, 5100 feet. Broke camp 7.15, crossing over a flooded river which breaks through the limestone wall from the north and is named the Chimbu, by means of a vine bridge which we had to reinforce before venturing on it. Camped on a flat terrace above the stream amongst the Mirani people; big areas of artificially planted casuarinas here. Broke camp 7.8 a.m. next day, climbed up a grass range to 6500 feet, where a thousand or so natives met us and cried "chimbu chimbu" in welcome; continued over grass ranges. The limestone wall turns north here. Camped among the Kunbi people; big population. Broke camp 7.30 a.m. Crossed over the Korin, a large stream coming off Mounts Wilhelm and Herbert following a west-north-west direction up and down deep gullies cut through the gravel bottom of an old lake by streams coming in from the sides to join the main river, the Wahgi, which meandered down the centre of the valley in a series of convolutions, in places almost meeting itself again. The Wahgi Valley from the Korin to Hagen is a huge gravel deposit up to 500 feet thick in places and the generally level appearance would suggest that above the miles of limestone gorge through which the river runs to join the Purari was at some time a huge lake, and the rivers on either side, tearing down from the mountains filled up the lake with gravel from the ranges. Gradually the river tore a channel through the limestone country until it drained the lake, then cut through the gravelly bottom, the feeders on either side doing likewise until we find it at the present time a series of level alluvial grass stretches of country cut through by streams with the main stream over 500 feet below the present level of the valley. Camped amongst Andimoima people.

April 6: Broke Camp 9 at 7 a.m. Up and down through intensely cultivated

areas and hundreds of people and located a level terrace which gave promise of making an aerodrome without too much effort, and camped. Next day a Fox Moth plane in charge of Pilot Grabosky, with Mr. Kingsbury, the N.G.G. Co.'s geologist, on board came in and landed on the aerodrome with stores, etc. We got on the road again still travelling along the northern side of the Wahgi River through swampy country, the gullies being wider and wetter and not so deep. Camped amongst the Kaga people, 5500 feet above sea-level. Pushed on over swampy grass flats, seeing the grassy top of Mount Hagen for the first time, and camped near the Orogaka people at 5500 feet above sea-level. Broke camp at 8 a.m. on the 16th and dropped down to the Ogumanits, crossing it by means of a few logs about 2 feet under the flooded surface, and waded waist deep through a flooded swampy area for two hours. The dogs could not do the long swim by themselves and had to be assisted by means of reeds tied round their bellies to keep them afloat. Crossed over an island-like grass ridge, rising up out of the centre of the surrounding swamp, and after plugging through another swamp not so deep but much muddier we camped near a small village on high ground alongside the river. Crossed back to the island next day. Climbed up and travelled along the main ridge, the highest point being 6000 feet. Dropped down into another swamp and after getting on to high ground camped amongst a large population. Pushed on for two hours and found another likely-looking aerodrome site at Jamga, and decided to level it off and have it ready for the aeroplane due here on the 27th.

April 27: Fox Moth piloted by Grabosky, with Mr. Kingsbury and District Officer E. Taylor, arrived and made a good landing on the new aerodrome. Waited here and prospected the surrounding country until May 9, when we pushed off again towards the north-east and reached the top of Mount Jaka, 9400 feet, on the Wahgi–Sepik divide on May 11. Camped here a day, looking around and on the 13th followed a northerly direction, cutting our road through heavily timbered ranges to the Zau River, reaching there three days later. The Zau River is a large stream coming off Mount Herbert and one of the tributaries of the Yuat. Not as thickly populated here as the grassy country over the ranges.

May 17: Followed down the Zau to its junction with the Jimi River, the biggest stream of the two, coming in from populated grass ranges to the north and east from the junction. Turned north or west through thick scrub country 2000 feet above sea-level and got on to native tracks. Camped near a bush village called Kawbin Kundubi, and found traces of gold in the Yen, a small stream nearby. Turned south from here through bush country up a steep grass range into more populated areas where we found the manufacturing centre of the stone battle-axes, and continuing on up steep timbered ranges reached the Wahgi–Jimi divide 7100 feet on Friday May 19. Dropped down into the Wahgi Valley and back to the base camp and aerodrome, reaching there on May 20.

May 31: Mr. R. Gurney in a Fox Moth took Dan and Mr. Taylor on a reconnaissance flight to the north and back to the aerodrome. Left base camp and aerodrome next day and crossed over undulating grass ridges approximately west of north-west and crossed the grass-covered divide 6500 feet above sea-level and continued down a grass ridge. Camped amongst

a big population near the Boiya River. Cut down 500 feet through a lava bed shed off Mount Hagen when it was an active volcano. A few miles below it flattened out and ran through a flat grass valley 3 to 4 miles wide. Thousands of people similar to the Mount Hagen lot living on grassy ranges and flats; lower down it again ran into a deep gorge and joined the Gai, coming in from the west, thence through steep gorges; cut through the generally level lava bed, 2000 feet above sea-level to join the Jimi coming in from the north-west; then cut through the timbered ranges and joined the Sepik River. (This I saw from the air in July 1934 while on an aerial reconnaissance flight.) We followed the river down on the eastern side of it, through patches of grass and scrub country, crossing the Gai by means of a suspension bridge on June 4, and passed through tropical scrub country 2000 feet above sea-level, and again crossed the Gai by a cane suspension bridge. Crossed unpopulated flats and camped on timbered island-like ridge rising out of the old lava bed near a small village called Kawbenaberi. Here one of Mr. Taylor's Markham boys who had been sick for a day or so died, and we buried him next morning, then went on down to the Jimi to prospect it. Friday morning turned south to get back amongst the populated ranges. The local people did not have much to feed our line of natives, and we camped amongst the Mungimbaw people 5200 feet above sea-level on June 10. A number of the boys had developed some sort of an illness, and as I was anxious to prospect the country as far as the Yen, Mr. Taylor and I pushed on in that direction on Monday June 12, leaving Dan and Spinks to get the sick natives back to the base at Mount Hagen as soon as they could. Followed a track down the timbered range to where the country flattened out in the Jimi valley 2000 feet above sea-level. Continued along the floor of the valley through tropical scrub country, crossing the Mawgabinya and Ganz rivers, arriving at Camp 49 on June 15. On June 16 we turned back to the base at Hagen, following our track of the previous month, arriving back at the base camp on the 18th. Dan and Spinks came in on June 20 with the sad news that Eyu, an Aitape boy, had, after a great battle, died on the top of the dividing range, and was buried there. He was a very fine type of a boy and is the one and only member of our line whom I have ever lost on any of our expeditions in this country.

July 3: Left the aerodrome. Climbed Mount Hagen and found it 12,600 feet above sea-level, arriving back at the base on the 8th.

July 17: Left the base at 7.30 a.m. Travelled almost due south and camped near where the Mogai aerodrome now is. Very largely populated, being in the undulating grass ridges and has, like everywhere else in this district, a plentiful supply of native foods, etc., which we bought for a few shells. Climbed to the plateau on the Wahgi–Nabilya River divide, 6500 feet, and found traces of gold in the streams draining the plateau, but decided as it was near our base camp to carry on and complete our trip and examine it later on. Travelled over bush path down into the grass ranges on the Nabilya fall, camping amongst the Benembi people. Followed down the Nabilya on the northern side through grassy flats and ridges and camped alongside the river, here cut deep into lava, near a village where we obtained food for the boys. Continued on down the river, up and down over deep gashes cut by the stream coming off the ranges through grass and bush country, reaching the junction of the Gowil and

Nabilya Rivers on July 21. Crossed the Nabilya where it runs in a narrow gorge through soft slate country and travelled back up the south side of the Nabilya through populated grass ranges and crossed it again on July 24; then along our track over the Nabilya–Wahgi divide and after prospecting the streams, arrived back at the base camp on July 30. After prospecting the surrounding country we pulled out for our first base camp at Bina Bina, travelling the same route as we came along and arrived at Bina Bina on October 19.

SIXTH JOURNEY, February–May 1934: Expedition west to north-west of Mount Hagen

Left Lae 6 February 1934, 7 a.m. In charge of a prospecting expedition financed by the New Territory New Guinea Company formed in Melbourne, Victoria, for the purpose of prospecting and exploring the country in the vicinity of Mount Hagen. With my brother Dan and thirty-five native carriers: thirty of whom as usual were armed in case of any trouble. Followed up the Markham River Valley over the range to the Kainantu Aerodrome 5500 feet above sea-level on the headwaters of the Ramu River where the administration had established a police post. Arrived there on Wednesday, February 14. Dropped over into the Purari River fall on Friday, February 16. Arrived at the village of Finintugu on the Kamamentina River about an hour too late to save a prospector, named Bernard McGrath, from being murdered by local natives. Dan went back to the Police Post on the Ramu to advise the administration authorities about the murder and I camped near McGrath's camp until he returned with a Patrol Officer the following afternoon. Spent another day assisting the Administration Officers to round up the murderers and after burying McGrath went on to the Bina Bina Aerodrome, arriving there on Wednesday 21st, and after cutting the grass, which had grown up after months of neglect, waited on a plane to bring in stores from the coast. Left there on February 27 for Mount Hagen, our last base camp in 1933, arriving there on March 15. Made a new aerodrome at Mogai and after getting more stores in by plane to the new aerodrome started off on Sunday, April 22, on a trip into the country south of Mount Hagen. Went west into the head of the Nabilya River and camped at Piuada 6500 feet above sea-level. On April 23 we climbed over the top of a divide 8300 feet above sea-level and dropped down to 7450 feet into the headwaters of the Nabilya River which swings back south-east, and rises in a swampy grass valley about 5 miles long and 3 miles wide. A few hundred natives live round the foot of the hills surrounding the valley.

April 24: Broke Camp 22 and while crossing the valley of the Nabilya we were ambushed by the people of Kumbugulp, but after a few shots got in touch with them and made friends, two of them being slightly wounded. Camped 2 p.m. 7800 feet. Got away from Camp 23 7.30 a.m., crossed over another range 8500 feet, dropped down into the Gauil River. Valley about 30 miles long, and 3 to 5 miles wide. Several thousand people living on the slopes of the hills round, the centre being mostly marshy ground. Found here houses over 100 yards long and 15 to 20 feet wide. We persuaded a

native named Keluwere to accompany us as an interpreter (we could speak to him through our Hagen people) to show him that we were peaceably inclined and to give the people of the surrounding country confidence in us. Got away from Camp 24 at about 6.45 a.m. next day. Followed down the Gauil River to where it ran through a gorge for 5 miles and again opened out into a wide valley 6000 feet above sea-level. A few hundred natives living on the grass slopes of the ranges round about and in the centre where the ground is drier.

April 28: Broke Camp 25 at 7.30. Followed the Gauil down through sparsely populated areas. In some of the villages were observed small cages or shrines built on sticks about 4 feet high, the shrine or cage being about 18 inches high and 1 foot square with a roof over it walled round with bark. Through a little peephole cut in the bark could be seen the skull and jaw bone belonging to a man and a larger shrine or cage had larger skulls belonging to deceased women of the tribes. These skulls belonged to relatives of the people of the village and are placed in these shrines after recovering them from the grave when the flesh has rotted away. Followed a stream down, which disappeared into a cave in the limestone country, coming out about 2 miles farther down and joining the Naribyu. Camped amongst the Gawdelpiri people; big population here. Saw a large number of steel axes and one big knife, the natives pointing in the direction of Papua when I asked where they came from. Broke Camp 26 at 7.10 a.m. next day. Went back along our track for about 2 miles and then travelled approximately south over a very bad track; roots and fallen trees being the only means of getting through the mud without sinking to the knees. Passed the Naw Gamilda and the Naw Paiinda, two large streams coming off Keluwere. Camped at 12 noon in a village on the Nagube. About five hundred people round our camp here. Plenty of native food and pigs. Broke Camp 27 at 6 a.m. on the 30th, travelling south along the foot of Keluwere. Passed a big lagoon about 2000 by 1000 yards, called Tangigi. Carried on at an elevation of 6500 feet above sea-level through bush, over swampy roads. Camped at 1.30 near another big lagoon or small lake, named Unimi, at 7350 feet above sea-level. Big population here. Here we found a silo-shaped tower about 30 feet high and 12 feet in diameter with a conical-shaped roof in a walled-off enclosure near the village. Crawled through a small door and inside we found a platform about 20 feet above the ground. Natives told us the old men perch themselves on it during ceremonies. A ladder built on to the wall led up to it. It was roofed with karuka leaves and the walls were karuka leaves and reeds. The Kanakas gave us to understand that it is a sing-sing or ceremonial hall used in the ceremony of removing and putting on the loaf-cheese-shaped headgear some of the men were wearing.

May 1: Broke Camp 28 at 6 a.m. Dropped down into another high valley 10 to 15 miles wide and 20 miles long. Passed through a group of seven houses over 100 yards long, divided into ten to eleven compartments with a separate door to each, thatched with reeds. These houses were new and had just recently been constructed. The natives gave us to understand they were used to house visitors, their families and pigs coming to ceremonial and trade gatherings. This valley, drained principally by a big river called the Mabigai,

between 6000 and 7000 feet above sea-level, and from the number of villages observed on the slopes and in the drier parts of the valley there must be between 8000 and 10,000 people in it. Followed a southerly course passing through the Gawiayump people. Camped 11.30 a.m. 6700 feet above sea-level in a village called Pawgubu. Got away from Camp 29 next morning at 7 a.m. Travelled over a very marshy track in the direction of a gorge almost due south where three streams which drain the Mabigai Valley came together and flowed on into grassed ranges and then turned south-east after being joined by a large stream coming from the west, called Ibiago. The Ibiago evidently drains another big valley to the west of us where, the local natives told us, dwell many thousands of natives. Passed through the village of Eyeri. Camped at 6600 feet amongst the Karuruda people. Saw a spoon hanging round a native's neck as an ornament, evidently traded in from Papua. Not much native foods brought along here, the natives appearing to be in a sort of daze and spent all the time looking at us and our camp instead of bringing us food. Got away from Camp 30 at 6.30 a.m. on the 3rd. Had an anxious few minutes getting through a split slab barricade which guarded the entrance to the next village, but got into touch with the natives without any trouble and induced them to put down their weapons. Camped 11.30 among the Kebigi Wagua people at a place called Pua, 6000 feet above sea-level. The main stream, still called the Mabigai, flows approximately east. Broke Camp 31 at 7 a.m. next day. Crossed a big stream called Yalbu, spanned by a vine suspension bridge. Country is now all limestone and shale. Followed approximately south-east and crossed the Nawmbidl, a large stream coming from the north, and followed this down to its junction with the Mabigai, the main stream, 5000 feet above sea-level running through limestone gorges and opening out into flats here and there. It is now a big, wide stream running fast and flowing east. We camped amongst the Abage people at a place called Warababi at 1 p.m. About three hundred people round our camp here. The gardens here are rounded beds, 4 feet across, only 6 inches to 8 inches high, having eight to ten slips of sweet potato plants in them. There is a high level expanse of country to the north-east of us, and the country appears to drop right away to the east. Found here a bark-shingled round house which the natives told us was used to cook pigs in at a dead man's death feast.

May 5: Got away from Camp 32 at 6.45 a.m. Crossed the Nuya Buram stream and climbed out up to the Luluabo people who, as usual, were all lined up in the village square to meet us. Crossed a wide expanse of level country and dropped down 300 feet to the Puru River, which is running in a gorge through volcanic lava. Across another flat area of grass country, down into the Runa River, a stream also running through volcanic lava. Climbed out of here up to Kumeana and camped at 1 p.m. Kawili, Kambigi, Yawam Komni were the names of surrounding villages we got from the people here. Broke Camp 33 at 7 a.m. on the 6th. Followed a gradually rising track through bush and patches of high cane-grass country and camped at 11.30 in a village called Ilyoi. This was a new village reconstructed after a recent intertribal fight. Still a considerable number of shrines with skulls in them. Got away from Camp 34 at daylight. Staved off an ambush prepared for us along the road by firing some shots into the cane grass, in which the natives were

hiding. Followed a faint track through bush country up and down limestone ranges. No natives in this area, so the boys slept hungry. Camped at 4 p.m. Broke Camp 35 at 7.30 a.m. on the 8th. Climbed up 500 feet on to the top of the range; could not find a track of any description, so cut our way and followed a compass course north. Found a native garden in the bush and camped. The next day the natives here escorted us to the main village, which we reached at 11 a.m., crossing a large stream called the Nawraguba, and two smaller ones, called the Nawrabin and Nawgibin, before reaching the village of Tabungl, 4100 feet above sea-level. Plenty of native foods here and the natives were very friendly.

May 10: Broke Camp 37 at 7 a.m. Reached the junction of the Kawmeri and Gauil Rivers. Had some difficulty in crossing the Kawmeri, eventually falling a tree across it and got over. Followed the Gauil up for three hours, along a rough track. Passed through a small village called Bawninga, and got to the junction of the Gauil and Nabilya Rivers about 1 p.m., where there was a vine suspension bridge which, after reinforcing with ropes we carried for this purpose, we crossed and camped at 5 p.m. in Pubu. From here back to the base camp which we reached on Saturday, May 12, we were in country explored by us in 1933.

SEVENTH JOURNEY, June–July 1934: Expedition west to north-west of Mount Hagen

Got in more stores, etc., by aeroplane, and on Monday, June 11, left our base camp at 7 a.m. on a trip to climb Mount Keluwere and thence follow the country north and west from Mount Hagen. Went over the divide into the Nabilya River, and camped amongst the Oga people. Broke Camp 41 at 7 a.m., crossed the Nabilya River by a vine suspension bridge. Camped at 5350 feet in Kawgalmeri Village. The people who live in the vicinity are the Tawgawaniga. Plenty of native food and pigs about. Broke camp at 6.15 a.m. on the 13th. Climbed over the 7800-foot divide and dropped down into the Gauil River. Camped at 12 noon on the southern side of the Gauil River 6500 feet above sea-level. Decided to leave the main part of the camp here in charge of our boys while Dan and I continued with a small line to carry our provisions, bed, etc., for a two-day trip to the top of Keluwere. Dan and I and twenty boys got away from Camp 43 at 6.30 a.m. next day. Followed a track up the mountain mostly through bush country, reaching the 9500-foot level at 12 noon, where the timber gave way to patches of stunted scrub and clumpy Alpine grasses growing out of the waterlogged ground. Continued on until 1 p.m. crossing over fairly extensive stretches of Alpine grass country dotted here and there by small water-holes and reached the 11,000-foot level and camped. Weather very clear and the mountains over 100 miles away visible. Broke Camp 44 at daylight on the 15th. Heavy frost during the night and the numerous small water-holes which dot the top of the mountain from the 10,000 to the 12,000 foot level were ice covered. Reached the 12,200-foot level at 9 a.m. From 12,000 feet to the top, 13,770 feet, was a very steep climb, reaching it at 11 a.m. On the south-west side of the mountain it fell away 3000 feet in an almost straight drop. Took bearings

from here and observed a new mountain to the west and north-west standing out above the surrounding country. Spent another night on the mountain, and on Saturday, June 16, went back to our temporary base camp on the Gauil.

June 17: Got away from Camp 43 at 6.30 a.m. Followed up the Gauil River on the northern side through grassy ranges and flat terraced country inhabited by the Yabulga, Pabagul, and Kunjuguli people. Camped on the north side of the Gauil near where we camped on Wednesday, April 25. Plenty of native foods here. In consequence of the good reports spread by Keluwere, whom we now brought back loaded with presents which we had given him after taking him around with us back to our base camp at Mogai, and after showing him the aeroplane, bringing bags of shells and native trade in from the coast, we had no difficulty in obtaining the services of another guide from this village. Remained in camp all next day straightening cargo. Broke Camp 45 on June 19, 7600 feet above sea-level; followed up the Gauil River on the northern side of the valley. Along a fairly good track over the flat and sometimes swampy terraces above the main stream. Many more people about than we first thought. The extent of the valley also was very much longer than we surmised in April, a long stretch of flat grassy terraces coming into view when we rounded the range towards the north-west. Reached the foot of the divide between the Gauil and Yuat Rivers, the latter being a tributary of the Sepik River, at about 11.30 and camped at a place called Bumbula. A big crowd of natives about and a good supply of native foods here. Owing to the wet nature of the ground the rounded garden beds, 8 feet to 10 feet in diameter, are heaped up 2^1_2 to 3 feet above the level of the ground. Broke Camp 46, 7600 feet above sea-level, at 6.30 a.m. next day and climbed up over the divide 9350 feet at 10 a.m., and dropped down into the Miump, a tributary of the Yuat, which rises on the south end of Mount Hagen. Passed through the Mune people who live at about 7500 feet. Camped at 1 p.m. among the Wileyer people in rugged limestone and volcanic country.

June 21: Broke Camp 47, 7100 feet above sea-level. Followed the Miump down on the south side. Crossed over and climbed up on to a long grass ridge. Followed this down to the Gai River, the main western tributary of the Yuat, crossing by means of a cantilever-type bridge, and camped on the north side among the Marabe people. Broke Camp 48, 5275 feet above sea-level. Climbed up to 6000 feet. Followed a westerly course on the north side of the Gai for a few miles through thickly populated flats, hundreds of people as usual following on behind, singing and yelling. Crossed the Gai to the south side by means of another cantilever-type bridge where we were met by a few thousand natives who escorted us through an intensely cultivated patch of terrace country. Camped at 12 noon among the Telawishas. These are a big, upstanding people, the men of whom do not wear bark belts round the waist as in the Hagen area, long lengths of plaited rope being used instead. They have distinctive styles in arranging their hair, it being moulded into different shapes, thick, matted masses overlapping their ears by 4 to 6 inches. Some of their mops are so huge that they fall down their backs, and most of them carry two long pointed wooden "ticklers" to keep the population in their heads on the move. Very little native trade here and no steel axes so far. The women folk wear a long tail-like rear covering made out of dried lignum

stacks, in some cases trailing along the ground behind them, and a frontal covering of the same material reaching to the knees. Broke Camp 49 on the 23rd, 6100 feet above sea-level. Followed the course of the Gai, crossing it twice by native bridges. It is now running very slow and deep, and with its banks lined with casuarinas and high grass is not unlike the western country streams of Queensland. A big mob of yelling natives accompanied us all day. They had a very unusual way of singing—all together, then a distinct pause, followed by a roar. Very big population in this valley, it being one of the most thickly populated and most intensely cultivated valleys I have yet seen in New Guinea. Camped at 1 p.m.

June 24: Broke Camp 50, 6400 feet above sea-level; hundreds more curious and noisy natives accompanied us. Followed along tracks parallel with the Gai which must have been wearing down for many years. Most of them are 6 feet to 8 feet wide and in some places resemble sunken roads, being up to 8 feet below the general level of the country through which they run. The Gai broke into two streams here, the larger branch heading towards the west and called the Gai, and the other branch towards the north-west called Ampo. Camped at a village called Doi at 12 noon on a dividing range between the two branches. The houses of the people here are about 30 feet long with a distinct hump in one end, thatched with grass, otherwise generally similar to the Hagen houses. About two thousand people collected around our roped-off camping area here, and led by a very talkative and pugnacious native who ran to his house, armed himself with two spears and urged the mob to attack us as soon as he threw a spear at one of our watch boys, they did so, with stone axes. In the subsequent fight fifteen of the natives were killed before they were driven off. Got in touch with them later and they told us, through our interpreter, that they thought we were defenceless people (firearms being meaningless lengths of wood to them) whom they could easily overcome and so acquire our (to them) valuable loads of shells. Broke Camp 51 next morning, 7800 feet above sea-level. Followed along the top of the ridge in a north-westerly direction. Dropped 2000 feet down into the Ampo and camped at 1 p.m. near the river amongst a big population. Broke Camp 52 on the 26th, 7450 feet above sea-level. Steeple-chased over deep gullies on the south side of the Ampo. Passed through the village of Tayok, where our boys at the back of the line were again attacked, spears and arrows being thrown at them, two more natives being killed before they retreated. Camped at 11.30 a.m. at a village called Rondeldai. Still amongst a big population. From June 26 until July 2 we stayed in Camp 53, 7700 feet above sea-level, owing to a very severe attack of gastric malaria from which Dan was suffering, and as he showed no signs of recovery I decided to carry him back to the base camp and get him out by aeroplane to a doctor. Here also we were surrounded and attacked by a big mob of natives, two more of them being killed in the subsequent fighting. On July 8 we crossed over a divide 9000 feet above sea-level on the southern fall of Mount Hagen into the Nabilya divide, and reached the base camp at Mogai on July 10.

EIGHTH JOURNEY, July 1934: Expedition east of Mount Hagen over Kaugel–Wahgi Divide down into Wahgi Valley

July 16: After getting more stores in from the coast by aeroplane left the base camp at 7 a.m. Crossed over into Nabilya Divide and camped near Gwemil at 11.30 a.m. Accompanied by the Fox Brothers who are putting in the time waiting on an aeroplane to bring in stores from the coast, their intention being to prospect the country to the Dutch border. Broke Camp 62 at 6 a.m. Several of the local natives accompanied us to have a look round the country. Followed a track round the mountain side, steeple-chasing up and down over deeply cut creeks, average elevation 5500 feet. Camped at 12.30 at a village called Kuga among the Benembi people. Broke Camp 63, 5800 feet above sea-level, at 6.30 a.m. on the 18th. Steeple-chased all day up and down deep gashes in the mountain side and then up on top of a timbered dividing range 6800 feet above sea-level. Followed along this ridge for an hour and dropped down into the Wemp—a fairly large stream running into the Gauil near Pubu and camped near Bethak. A few hundred people about here. From to-morrow it is new country, and as far as we know it is all bush with very few native inhabitants. According to our map we have approximately 90 miles of very rough heavy-timbered country to cross over. Everything will depend upon whether we can connect up with a village each night. Failing to do this we will either have to break through the central mountain block or go back to Mogai base camp and get rice in from the coast and carry it with us. Broke Camp 64 next day, 5050 feet above sea-level. Followed a very muddy root-strewn track through bushy country down to the main northern branch of the Wemp. Climbed over the divide and dropped down into the Gwabi, the other branch of the Wemp 4000 feet above sea-level. Climbed 2500 feet up a very steep track through bushy country principally stepping from root to root. At 6500 feet found a village called Vega living along the top of the ridge which for a distance of over half a mile had been levelled off to a width of a chain or so and a row of casuarinas and other ornamental trees and shrubs were planted along each side. Ornamental shrubs and brightly coloured plants evenly spaced apart were planted in the centre along the whole length of the levelled portion in raised mounds 4 feet 6 inches to 5 feet in diameter and 3 feet 6 inches to 4 feet high, the outside of the mounds having split slabs and bark firmly bound round to hold the earth together. Camp 12 noon. Plenty of native foods here.

July 20: Broke Camp 65. Rain very heavy all night. Could not get away until 7.30. Having to start then in a fine misty rain. Crack ran round the side of the mountain and down into a stream called the Aru, 4100 feet above sea-level. Climbed up to 5900 feet on to a range, from here followed round the side of the mountain again from three to four hours, thence down a long spur to a small village called Kelgu, where we camped at 5 p.m. A long arduous day's march through thickly timbered country. The track a series of steps from root to root, log to log and mudhole to mudhole, with rain pouring down at intervals. Very little native foods here and only thirty or forty people, and cannot see much hope of breaking through the bush if we are to depend on natives on the road. In Camp 66 the local natives were

emphatic that we would not be able to get through the bush. They told us there were very few people towards the east and in any case we would not be able to cross a large stream coming off the centre mountain block which was at present in flood from the continual rain. Went down and had a look at this stream. Took us about two and a half hours to get there, and at about 10 a.m. came to a stream called the Vildai, a torrent tearing along down the mountain side and full of conglomerate boulders the size of a tent. We could have got over by felling trees across when it had gone down, but this would have necessitated our waiting at the camp for a few days for the rain to abate and even then do not think we could go far without rice, so decided to turn round and go back to the base camp. We reached there on Wednesday, July 25.

NINTH JOURNEY, August–September 1934: Second attempt east of Mount Hagen over Kaugel–Wahgi Divide down into the Wahgi Valley

August 27: Left base camp after getting in some rice by aeroplane from the coast. This time accompanied by Mr. J. L. Taylor, who was spending part of his leave on a sort of busman's holiday, tramping around this new country. The Fox Brothers had left a day or so before on their expedition to the Dutch border. Camped at Kelgu at 2.30 p.m. on Friday, August 31. From here on it is new country.

September 1: Broke Camp 73 at 6.20 a.m. in clear weather. Climbed down steep track to the Vildai, 3500 feet above sea-level, which was now running normally. Took us an hour to cut a tree down to enable us to get across it. Climbed up to the top of the Vildai Divide 4500 feet down into the Gang. Another 1500-foot climb to the top of the Gang Divide and then down into the Moiya. Up again and down into the Kawgal and up and around a long spur to a village called Bagai, where we camped at 5 o'clock p.m. A few natives here and very little native food. Broke Camp 74 at 6.15 a.m. next day, 5700 feet above sea-level. Climbed down into the Bagai, a fairly large stream which we crossed by means of a lawyer-cane suspension bridge, losing over an hour in getting the line over. Climbed up a steep track through the bush to the top of the Bagai Divide, 6700 feet. Followed this ridge along for two hours, finding a good look-out on the side of the mountain, but unfortunately could not see anything on account of a thick mist which obscured everything. Followed along the top of this ridge and dropped down into the Dendabunt and climbed round the range and up to the small village of Orata, where we camped at 2.45 p.m. Only ten or a dozen people here. Very little native food. Broke Camp 75 at daylight on the 4th, 5300 feet above sea-level. Followed a track around the side, and up to the top of the range, then dropped down into Oru. Climbed up out of this over a timbered range and dropped down into the Paldi, which is a very large stream. Followed it along on the western side, where it ran into a gorge 15 feet to 20 feet across, and crossed by means of a lawyer-cane bridge. Camped at 12 noon in the bush 3900 feet above sea-level, at a place called Muru. Broke Camp 76 at 6.20 a.m., 3900 feet above sea-level. Climbed up a steep muddy track through bush, getting a glimpse of peaks on the top of the dividing range or central mountain block for which we were making. Climbed up to 8000 feet,

then followed along the top of the ridge for three hours, passing a native camping place on the Koidendenoil 7350 feet above sea-level at 12 noon, which is just a very small cleared patch in the bush used as a camping-place for parties travelling from the Wahgi to the Kaugel. Another hour's march along the ridge brought us to Gibichibubu, which is also a small camping area, and camped here at 1 p.m., 7625 feet above sea-level. A very uncomfortable camp on the ridge amongst the sodden, moss-covered timber on the muddy ground. Broke Camp 77 at 6.25 a.m. on the 6th, 7625 feet above sea-level. Climbed along the same ridge as we were on yesterday, on and up through the now stunted timber and bushes, and the ground where there were no roots was wet and muddy. Reached a small cleared patch at 9 a.m. Climbed round a steep side of the mountain gradually ascending and reached the Wahgi–Kaugel Divide, 10,000 feet above sea-level, at 11.30 a.m., and camped. Firewood was very scarce and the boys were very cold, huddling themselves up on the wet ground. Broke Camp 78 next day, 10,000 feet above sea-level after climbing up to the 11,000 level and taking some infra-red panoramas of the surrounding country. From the 11,000-foot level got a wonderful view of the country for many miles to the south and west in Papua. From the area of grass country observed I think I under-estimated the population when I said 25,000 from Keluwere: there must be 50,000. The Wahgi valley was below us, but we could see only a narrow section in the vicinity of the Minj. Mounts Herbert and Wilhelm stood out and I took several photographs and panoramas and at 10.30 a.m. pushed on down the range towards the Wahgi valley, camping at a village called Kawga, 6700 feet above sea-level, among the Kwilga people. Plenty of native food and pigs, so the boys are making up for the last eight or ten days in the bush. Broke Camp 79 at 6.10 a.m. on the 8th, 6700 feet above sea-level. Followed down the Minj River, crossing and recrossing it by means of a few long saplings thrown across it where it gorged and was narrow enough for them to reach. In one place it was only 7 feet to 10 feet wide, the stream rushing through a bellied-out channel 30 feet below. Got on to the track which Dan and I travelled along early this year and camped at Jimbuna, where we met several old friends. From here on we were in country visited before and followed up the Wahgi River, reaching the base camp at Mogai on Tuesday, September 11, at 2 p.m.

TENTH JOURNEY, October 1934: Trip down the Wahgi Valley to China Shiva, thence south over the Wahgi, east along the Wahgi, north-east back over the Wahgi to Irimbadi, object being to prospect the country and find out if the Wahgi is the same river as the one seen by us in 1930 and then called the Maki, running into the Purari.

October 3: After again outfitting from stores, etc., brought in by aeroplane, left the base camp at Mogai at 9.30 a.m. As usual over a hundred of the local natives were lined up waiting to accompany us. Selected twenty of the best and brought them along here. Followed the Wahgi down to China Shiva. Prospecting the country and arriving at China Shiva on Wednesday, October 17, at 11 a.m.

October 20: Broke Camp 96 at 6.30 a.m., 6500 feet above sea-level, several

of the local natives coming along with us to have a look round the country. Climbed up a long ridge to 8000 feet and then followed a bush track for some hours, dropping down to where the Wahgi is running through a limestone gorge about 2000 feet deep, and camped at 12 noon 6100 feet above sea-level amongst a big population. Broke Camp 97 at 6.30 a.m. next day, 6100 feet above sea-level. Climbed down into the Wahgi 2000 feet below, running through a very steep gorge, the last 500 feet being practically straight up and down. This was one of the few places where it was possible to ascend or descend this gorge. The stream here was narrow, being only about 30 feet wide, and was spanned by a vine bridge which we had to reinforce with ropes carried for that purpose before attempting to cross. Climbed up the other side of the gorge to 7000 feet and camped on top of the range near Daua village among the Yauveis people. Broke Camp 98 at 6.30 a.m. on the 22nd, 7000 feet above sea-level. Passed through part of the villages which had only recently been burnt out. The remains of their flattened-out gardens and burnt-down homes in evidence on the small flats just below this ridge. Their artificially planted groups of casuarinas were also ring-barked by the stone axes of the invaders. Carried on south, dropped down 1000 feet into a small stream, thence up 500 feet on to a grass ridge. Followed it along through more evidences of native wars and then the Abe people seeing us coming and thinking that we were the Yauveis come to invade them, immediately attacked us from the cover of the high cane grass on either side of the track, and before we could convince them of our friendly intentions they landed several arrows close to our line of boys, to which they replied by firing some shots. However, no one was hurt and we were able to get in touch with them and pass through their village. We climbed up to 6800 feet to the top of another grass ridge. From here we could see into the Kaugel valley south-west from us and we could also definitely see that the Kaugel does not run into the Wahgi as we had thought previously. It probably forms another branch of the Purari lower down. From here we could also definitely see that the Wahgi ran into the Purari and is the same stream as the Maki seen by us in 1930 on our trip through New Guinea. Camped at 12 noon amongst the Seana people. Broke Camp 99 at 6 a.m. next day, 5800 feet above sea-level. Climbed down 2000 feet into the Wahgi again to where a very frail vine suspension bridge spanned it. The Wahgi still a raging torrent, tearing along in a series of rapids. It took our Waria boys over an hour to strengthen it with ropes, the last of the line crossing at 12 noon, the dogs even being tied to the boys' backs to prevent their trying to swim and being dashed to death. Climbed up the steep side of the gorge to 6000 feet and camped near the village of Kabuguma. Plenty of native foods and big population here. Broke Camp 100 at daylight on the 24th, 6000 feet above sea-level. Climbed on up to 7200 feet. Hundreds of natives met us and came along with us with not a bow or arrow in sight, which speaks volumes for our method of breaking them in from the start, word that we would not tolerate weapons of any kind having reached them from the Marifutiga river about 10 miles to the north. Followed the range around, taking two infra-red panoramas of the country. Gradually swung round to the north-west up and down, steeple-chasing over 500-foot to 800-foot gullies through big villages and huge areas of gardens, through a bush track

under Irimbadi which dominates the country about here. Irimbadi is a limestone wall sheer, over 3000 feet on the southern side and running comparatively straight east and west. From the Wahgi Valley we are looking along it and so see only a triangular-shaped peak. Camped at 2.20 p.m. among the Tamamuru, who are around our roped-off camping area in hundreds offering all sorts of native foods and their buxom young women. The boys are busy picking out their sleeping partners for the night and obtaining from us the necessary shells with which to foot the bill in the morning! Broke Camp 101 at 6 a.m. next morning, 7000 feet above sea-level, a long line of natives accompanying us. Passed along the foot of the Irimbadi through several fairly large villages. Some of them barricaded by 15-foot to 20-foot high split slab fences just recently erected. Followed down the grass range to the Marifutiga river and camped above it on the east side. From here on we were in country explored in 1933.

DISCUSSION

Before the paper the CHAIRMAN (Admiral Sir WILLIAM GOODENOUGH) said: The President, much to his regret and very much more to ours, has an engagement which prevents him being here to-night. He has asked me to take his place.

To those who say, and sometimes write, that the last veil has been torn from the face of the earth—to all such I would say go to New Guinea and Papua and there they will find many new things. Whether it is advisable and desirable for the people who live there that that veil should be entirely lifted is a point on which, if there is time, I may say a word or two later in the evening. But one man who has lifted that veil, to a certain extent, perhaps no more than a corner, is Mr. Michael Leahy, who is going to speak to us to-night. He and his two brothers at different times have spent some eight years in New Guinea and Papua.

When Mr. Michael Leahy left school he became a railway clerk, but the stool on which he sat became shiny with the impatience of his movements. The open air, manual work, adventure, claimed him, and it is in New Guinea that most of his years have since been spent. We are anxious to hear what you have to say, Mr. Leahy. You may be frank with us.

Mr. Leahy then read the paper printed above, and a discussion followed.

The CHAIRMAN: We have Mr. Louis Clarke with us this evening. I am sure that what we have seen will provoke him to make a few remarks.

Mr. LOUIS CLARKE: There are one or two points which specially impressed me. For instance, the photograph of the man who had been killed with a stone axe was exceedingly interesting. We know that people were killed in the past with stone axes but we had nothing showing the effect of being hit by such an axe. The photograph we saw depicted the extraordinary amount of damage that can be done by that weapon. I imagine that stone axe went at least 3 inches into the man. Those axes are peculiar.

The ordinary stone axe blade of New Guinea has its lateral edges rounded or sharp, but that from Mount Hagen has flat sides. Of this Indonesian type only a few blades were known from New Guinea and their significance was problematical. It now appears that these blades were made in Mount Hagen region and were traded thence for the much-valued marine shells. Hence a few reached the coast. The spears used by the Mount Hagen people are also quite unlike any other New Guinea spears.

I congratulate Mr. Leahy on his wonderful photographs. I believe he brought back six thousand.

The CHAIRMAN: Major Fuhrman, would you say a few words?

Major O. C. W. FUHRMAN: I am glad of this opportunity to say a few words, for it enables me to express, on behalf of the High Commissioner of Australia, Mr. Bruce's regret and keen disappointment that he was unable to be present this evening.

Members of this learned Society are aware that Australia assumed a heavy responsibility when it accepted a mandate over the Territory of New Guinea—the country of which Mr. Leahy has spoken.

The mandates system which in the early days was described by some as a bold essay in altruism, imposed upon certain states the delicate task of ensuring the well-being and development of peoples not then able to stand by themselves under the strenuous conditions of the modern world.

The story of the Australian Administration in New Guinea is an absorbing one—absorbing alike in its inevitable minor failures and in its major successes—and, to those who have watched the development of the territory and of its people, there is abundant evidence to prove conclusively that Australia has fulfilled its sacred trust in the spirit and letter of the mandate.

In the fulfilment of that task the Administration is fortunate in numbering among its non-indigenous unofficial population intrepid men of the calibre of Mr. Leahy, and so far as this evening is concerned, thanks are certainly due to the Royal Geographical Society for its initiative in arranging for Mr. Leahy to give the interesting talk to which we have listened.

The CHAIRMAN: Before I voice that appreciation and make the comment which is the privilege of whoever occupies the Chair on these occasions, there are one or two words I should like to say of my own entirely. Neither be alarmed nor disappointed. It is nothing startling in the least.

To the ordinary observer there comes of course the question: What next? That is a question which has already been answered, to a certain extent, by Major Fuhrman, and we all may be assured that under the mandate and with such men working under the Australian Government—it is almost invidious to mention names but I will mention two, Sir Hubert Murray and Mr. Chinnery—everything will be done to preserve the peoples of whom we have heard this evening, for it is the peoples that have formed the chief interest of this most interesting evening. How are you going to consider them? Are they going to be left to develop their forms of government such as they are? We have seen that human life in that part of the world is pretty cheap. I wonder if it would be better looked after when or if the iron and the steel age succeeds stone. (When you leave this hall you will see outside the most interesting and, in some cases, very beautiful examples of Stone Age implements.) Are the people to be left alone? What is going to happen?

I would not for a moment from this platform—it would not be the proper place—dare to say anything indicative of what should happen, except to say that we do hear in this hall that certain areas in this country need protection from what is called the depredations of man; that in other countries the flora and fauna are being protected—how far and in what direction is the march of man going to interfere with these people? It is not perhaps a geographical question, but it is one of immense importance, and I would put forward, very strongly, as I say from myself entirely, with no authority or responsibility other than my own, that every possible care should be taken that the people of New Guinea and their country are not in any way exploited.

There comes for some reason—perhaps my age has something to do with it—

what is called that very difficult question of the missionary, how far he is to be allowed into this country, or not. Naturally if there is going to be humanitarian effort to help these people, missionaries cannot be excluded. I go so far as to say that it would be an advantage if only the one denomination would talk to these childlike minds, so that their minds are not complicated and filled with all sorts of different views of a common object. But that is enough now and here. If I want to air my views upon such subjects and elaborate them, I will use some other channel more suited perhaps to the purpose.

I remember years ago having a conversation with my very great friend, Hugh Clifford, well known of course in this Society and to you all, then in the heyday of his strength and powers. He said: "You know, when I meet men who have had to do with natives I ask myself, or the man, if I know him well enough, 'What is your intention towards the native. Is it to help him or to make use of him?' And by his answer, so I judge him."

I would repeat, especially after what Major Fuhrman has said, that that question is safe in the hands of those to whom the mandate has been given.

Now, to speak on your behalf and on behalf of the Society, we thank you, Mr. Leahy, for the very interesting evening you have given us. It is easy enough to show films and the pictures of marches over strange countries, but we here know how much determination is necessary to go through with such expeditions, and although there have been some differences we know, Mr. Leahy, that you have an admiration for and sympathy with these people. On behalf of this audience and the Society I offer you our cordial thanks for what you have shown and told us.

REVIEWS

EUROPE

PEDALLING POLAND. By BERNARD NEWMAN. *London: Herbert Jenkins* 1935. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 308 *pages; illustrations and sketch-map.* 10*s* 6*d*

In 'The Blue Danube' Mr. Newman wrote of his experiences during a bicycle tour of south-eastern Europe, and particularly in those districts which have changed hands under the Treaty of Versailles. The setting of his new book is in another zone of discontent. Landing at Danzig, he was bound to be intimately concerned with politics from the moment of his arrival, and the main points of his tour—the Polish Corridor, Gdynia, Poznan, Warsaw, Katowice, Krakow, Przemysl, Lwow, Brest-Litovsk, Wilno, Kaunas, and Memel—are names which have caused many politicians searchings of heart in the past, and will continue to do so for some time to come. Mr. Newman's account of the Polish people and the government of the new Poland is wholly favourable, and he has the very good sense to understand that nations such as Poland and Lithuania, which have for centuries been rigidly repressed, cannot be expected to produce in a few years a class of leaders comparable with those of their more fortunate neighbours who have a history of freedom rather than of repression. He makes it clear that in the north, as in the south of Eastern Europe, it is impossible to draw ethnologically exact frontiers; but he does not despair of satisfactory settlements of any of the immediate problems of this part of Europe, save one. The questions of the Polish Corridor, Danzig, Silesia, Wilno, and Memel can all be settled, he considers, with good will and good sense on both sides; but the problem of the vast populations of almost pauper Jews throughout all the towns of Poland he regards as serious and apparently insoluble.

The book is more serious than its title would suggest. It is amusingly written, and Mr. Newman seems able to find excitement and romance in the most unlikely places. His bicycle becomes almost a human personality in the course of the narrative, and the reader feels really relieved when "George" finally leaves the dust and mud tracks of Poland for the good metalled roads of East Prussia.

M. C.

THE LORDSHIP OF THE ISLES: Wanderings in the Lost Lordship. By I. F. GRANT. *Edinburgh and London: The Moray Press* 1935. $10\frac{1}{2} \times 7\frac{1}{2}$ *inches;* 514 *pages; illustrations and sketch-map.* 21*s*

Miss Grant's book is partly a guide book which would make an excellent (if bulky) accompaniment to any tour of the Highlands, and partly a study of the art, culture, and history of that part of the western Highlands and Islands, from Lewis down to Islay, which constituted the Lordship of the Isles. It is inevitable, though by no means regrettable, that neither function should be quite satisfactorily fulfilled.

To give any idea of the contents of a book which wanders so charmingly and romantically through the past is almost impossible. The outstanding fact of the period with which the first part of the book deals (*circa* 503–790) is the intimate connection between Ireland and the Scottish Highlands, the two forming a centre of Gaelic culture, with religion, art, and literary forms in common. The authoress deals at length with the debt of Scotland to Ireland, section two being devoted to Iona and its saint, whose tradition "has continued as a living force right down the centuries, forming a focus for religious settlement and the art of stone carving." Descriptions of the social polity, customs, morals, and sagas of

the Vikings are woven with great skill into Miss Grant's account of their two centuries of somewhat precarious power in the Isles (*c.* 1050–1266). The formal cession of the Isles to Alexander III of Scotland was followed in time by the gradual rise to power, partly by sagacious marriages, of the descendants of the able Somerled of Morvern, until in 1354 John, Lord of Islay, assumed the title of "Lord of the Isles." It was not until 1493 that sufficient pressure was brought to bear by the Scottish Crown to make the fourth holder, John, Earl of Ross, resign his romantic title.

Miss Grant's thesis, so far as she has one, is that with the fall of the Lordship was involved the destruction of the native Gaelic culture. "In looking at the later monumental carvings," she says, "one feels that the spirit and individuality of the artistic expression of the people had been lost, just as they had lost their natural political leader. And it is a striking fact that by far the greater number of the typical carvings are to be found in districts once closely associated with the Lords of the Isles." It may be open to doubt that the tribal organization which the author describes as existing under the Lords of the Isles, with its constant inter-clan feuds, could ever have ensured the peace and prosperity necessary for the development of a high civilization. Art in all its forms can flourish but spasmodically in the midst of such constant alarums as Miss Grant describes. But every reader will agree that her notes, steeped in Gaelic lore, on the ancient stones, carved, holed and rounded, which she met on her expeditions, accompanied as they are by artistic sketches, are among the most interesting features of the work. This large and handsomely printed book, with its ripe learning and dreamy enthusiasms, will be a guide-book to read at home. Were Miss Grant to write a formal history of the Isles, it would probably run to many volumes; but her easy scholarship and the charm of her writing are probably most effective in a volume of personal wanderings into the past such as this is.

E. L.

BALTIC COUNTRIES. A survey of the peoples and states on the Baltic with special regard to their history, geography, and economics. Vol. I, No. 1. August 1935. Toruń: Baltic Institute. $9\frac{1}{2} \times 12\frac{1}{2}$ *inches; 151 pages; diagrams*

ESTONIA, POPULATION, CULTURAL AND ECONOMIC LIFE. Edited by ALBERT PULLERITS. *Tallinn: (Estonian Publishing Co.)* 1935. $9\frac{1}{2} \times 6$ *inches; 226 pages; illustrations and map*

ESTONIAN ECONOMIC YEAR-BOOK, 1934. *Tallinn: Eesti Pank* 1935. $9\frac{1}{2} \times 7$ *inches; 120 pages; diagrams*

The first of these publications is by far the most important: it is the first issue of a periodical issued by the Baltic Institute (Toruń, Poland) and is, according to the editor's statement, designed to provide general information about the states and peoples of the Baltic region with special regard to their history, geography, and economic organization. Since hitherto such information was obtainable only with difficulty, being widely scattered in the form of monographs and articles in various languages printed haphazard in collections and periodicals whose existence was often unknown in this country, this attempt to present a connected survey, reliable book reviews, and above all a good bibliography, is very much to be welcomed. As the Baltic Institute has its headquarters in Poland it is not surprising that the number of Polish contributors and articles dealing with Poland is considerably greater than that allotted to the more obviously Baltic states: it is to be hoped that the growing sense of Baltic solidarity which this publication sets itself to foster will in time redress the balance, and that more information will be provided about, *e.g.* Lithuania, which appears to be unduly neglected. This criticism should not however be taken to detract

seriously from the value of such a collection as this: the articles, to take but a few, on the climate and population of the Baltic, on its coastal barriers, and its foreign trade, are brief but careful and accurate pieces of research. No less admirable is the demographic survey of Estonia, a country which seems to produce a greater number of scrupulous and well-trained scholars than its size and geographical position would lead one to expect.

This is borne out by its Economic Year-book for 1934, which is excellently edited, and still more by *Estonia*, a semi-tourist pamphlet, which is full of varied and well-presented information, and is commendably free from the excessive nationalist bias which distorts much of the literature exported by its neighbours and adds interminably to the labour of disinterested researchers anxious to obtain reliable data. Local pride and patriotic propaganda, most conspicuous in the Polish contributions, is agreeably absent from the writings of the Danes, Swedes, and Estonians; it shows itself principally in the historical and sociological articles, but is hardly present at all in the articles of purely geographical interest, which in any case are very few in number. I. B.

EUROPE. By SAMUEL VAN VALKENBURG and ELLSWORTH HUNTINGTON. *New York: John Wiley & Sons—London: Chapman and Hall* 1935. $9\frac{1}{2} \times 6$ *inches;* x+652 *pages; maps and diagrams.* 23*s* 6*d*

This volume is refreshing because of the method of its production; the first draft being written by Dr. van Valkenburg and the script re-written by Dr. Huntington. As a result some chapters bear the impress of the former's technique and some the hallmark of Huntington while the remaining chapters are an infusion of both. Never does the book consist of isolated chapters which have been written without knowledge of the collaborator's efforts. Part I has seventeen chapters on the continent as a whole; in which Huntington has expounded fully the theories he has made his own. Part II has a regional treatment which commences with the lands of the Baltic and passes by way of western Europe to the Mediterranean, thence by the Danube lands to Soviet Russia. The volume is rounded off by diagrams of commerce and productivity, lists of cities of the continent with more than 100,000 souls, a valuable bibliography and an extremely useful index which has been subdivided to render the search for a topic easy.

The essential themes of the book are the dominance and diversity of the continent and the first part shows how the geographical background is necessary for an understanding of the problems due to over-population, political tension, and social unrest. The first map in the book divides the continent into cultural zones, A, B, and C. The first surrounds the North Sea and stretches across to Marseilles, the Po basin, Vienna, Riga, Lulea, Oslo, and Trondhjem. Zone B fringes this with an extension to Vigo. The third zone comprises the bulk of eastern Europe and the Mediterranean lands. Successive maps as A20 and B20 (the number refers to the page and the letters show the position on the page, A being above B and B above C), and A23 reinforce the essential truth of this generalized statement. The main thesis of the volume, this differentiation into levels of attainment has been kept constantly to the fore. Most English readers will turn to the pages dealing with their homeland. Unfortunate inaccuracies mar the text on the British Isles and even though not, in many cases, sufficient to alter the argument, tend to cast doubts on the book as a whole. The description of the fishing along Scotland with the "sheltered north-east coast" and the lesser development on the west coast "because the open Atlantic with its fogs and gales offers too great a handicap, or because the barren land does not provide the timber so necessary in building boats" is erroneous and disappointing. The map A288 purports to show, among other things, the productive coalfields, and while

the absence of Brora is excusable the Fife, Midlothian, and Kent fields should not be omitted. The text also bears blemishes, as that Glasgow owes its growth in part to the deep water of the firth and river allowing large vessels to enter. The treatment of London as the metropolitan centre is happier in its freedom from error and the bold and clear statement of the rise of the site to domination in the population nuclei of these islands. The importance of the Channel packet ports as parts of the real contact between seaborne traffic and the consuming centre of London is clearly brought out in the chapter on Industrial Britain.

The chapter on "The country of the Soviets" is one of the best, since, to use the authors' own words, "among all the countries of Europe there are none where the influence of geographic environment upon occupations, human character, and political and social development is more conspicuous than in Russia. . . . In Russia we note them especially because of the contrast with the rest of Europe." The first treatment of the republic is a clear statement as to the relative size and utilization of the whole, not just European Russia, as against the continental part of the United States; the uniformity of the republic, allowance being made for its vast size, and the isolation from the important seaboards of the world. An unbiased statement of the distribution of Russian industries and the geographical and political causations for their sites is briefly given. The diagram and adjoining argument on p. 593 show how, with one or two exceptions as coal and iron, the industries measured by production trends of 1880 to 1910 are no greater now than they would have been under the former political control.

The other chapters in this volume show a similar set of statements which imply recourse to official figures as well as the various published books. A valuable feature is the constant analogy drawn between similar conditions in other parts of Europe and the many references to historical events showing how they fitted into their environment. This volume is not a mere compilation but shows, even if one does not agree with the theories presented, how the geographical picture of such a diverse unit as Europe can be explained on a coherent system. The work is to be recommended as a stimulating treatise as well as a reference volume, and when in the next edition the blemishes have been removed it will be even more useful. A. C. O.

ASIA

SOME AGRICULTURAL ENTERPRISES IN MALAYA. By M. J. KENNAWAY. (*Kuala Lumpur* 1934) [*London Agents: The Java Head Bookshop*]. $10^1/_2 \times 7$ *inches; 132 pages; illustrations.* 6*s*

One of the most difficult problems in applied science is to maintain an effective liaison between the research worker and the "practical man," so that the results achieved by the former may be utilized quickly and effectively by the latter. This problem is perhaps most acute in agriculture, largely owing to the innate caution and conservatism of those who work on the land. Any effort therefore that aims at bridging this unfortunate gap should be warmly welcomed.

Mr. Kennaway, in the present volume, has gathered together a series of articles reprinted from the *Straits Times* describing his visits to plantations and experimental stations in Malaya during 1933 and 1934. He writes essentially for the practical planter and endeavours to show him what work is being done to improve the methods of cultivation of existing crops and to introduce fresh ones. Much space is naturally devoted to rubber, especially the development of controlled forestry methods to supersede plantation cultivation, a change in which the author places great hopes for the future. Of particular value are the two articles devoted to the Central Experimental Station at Serdang. It is to be

hoped that estate owners will adopt Mr. Kennaway's suggestion of carrying out miniature experiments of their own to supplement the large-scale work at Serdang. Co-operation of this type between the Department of Agriculture and planters cannot fail to give valuable results, especially as regards the suitability of the climate in different regions for new crops and the possibility of their commercial exploitation.

Mr. Tempany, the Director of Agriculture, supplies an appreciative foreword to the book, which is fully illustrated. The style is perhaps somewhat prolix and journalistic, and the quality of the printing is in some places poor. These however are small defects in a volume which should do much to aid both the planter and the research worker in their co-operative task of improving Malayan agriculture. J. S. L. G.

GRASS FOR MY FEET. By J. VIJAYA-TUNGA. *London: Edward Arnold & Co.* 1935. 7½×5 *inches;* 230 *pages.* 6*s*

CEYLON: NEW AND OLD. By ST. NIHAL SINGH. (*Colombo*): *Ceylon Government Railway* [N.D.]. 9×8 *inches;* 96 *pages; illustrations and railway map*

The first of these books is a collection of sketches depicting life in a village in Ceylon. The author was born and brought up in the village of Urala near Galle, and he describes with much lively detail the people and events that went to make his childhood. He introduces the leading characters of the village, many of whom are his relations: Kandé Mama, the Hill Uncle, who lives in dignified and prosperous isolation, Caroline Auntie whose "widowhood has been a chequered one," Paré Gedera Auntie, the Aunt of the House by the Road, who is abnormally prone to possession by devils, and many others. He describes some of the mildly exciting events that disturbed his family life: the building of a new house, a visit from the Priest, a bathing party, and a shopping expedition into Galle. The book contains also vivid impressions of the village scene on such public occasions as Vesak, the Harvest, New Year's Day, a wedding and a ceremonial devil-dance. Mr. Vijaya-Tunga has a remarkable gift for descriptive writing. His pictures of the jungle with its fruits and "friendly" rocks, of an afternoon of rain and of the cluster of shops at the cross-roads, "the nearest we have to a town," are both graphic and imaginative. The book does not profess to be of any documentary value. The treatment is far too subjective for that, but it gives nevertheless a full and interesting picture of life in an agricultural community as yet barely touched by European influence. The author is obviously a highly cultured man, but it is a pity that he has set out to identify himself with the reader and has adopted an external, slightly patronizing attitude to his subject. It would have been more satisfactory if he had been able to recapture the unsophisticated outlook of his childhood, and had presented his village from the view-point of the villager.

While Mr. Vijaya-Tunga's style is too cold and artificial for his subject, Mr. St. Nihal Singh errs in the opposite direction. 'Ceylon, New and Old' is a volume issued by the Ceylon Government Railway presumably with the intention of attracting visitors to the Island, for much of it is written in that unrestrainedly ecstatic vein which one associates with advertisements for Sunshine Cruises. It does not attempt to present a faithful picture of Ceylon, partly because it ignores the less attractive aspects of the life of the Island, and partly because it deals only with the Ceylon that is accessible to the casual tourist. Since it is for the intending tourist that the book is written, a large amount of space is naturally devoted to the buried cities of Anuradhapura and Polonnaruwa, and here large chunks of myth and history are rather confusingly inserted.

Stories are dragged in which do not help sufficiently to a better appreciation of the famous ruins to warrant their inclusion in a book of this size. The purpose of the book, namely to attract visitors, is best served when the author confines himself to stating the bare facts about the places of interest and leaves his excellent unretouched photographs, which adorn every page, to tell their own tale. P. S.

MALAYAN SYMPHONY: . . . Straits Settlements, Federated Malay States, Siam, Sumatra, Java, and Bali. By W. ROBERT FORAN. *London: Hutchinson & Co.* 1935. 9½×6 *inches; 302 pages; illustrations and maps.* 18*s*

The author states clearly that the book represents his impressions when making a quick tour along the known ways of Malaya, Siam, and the Dutch East Indies. He lays no claim to originality beyond that the impressions and opinions are his own. He hopes to entertain and to inspire others to visit these countries. As may be surmised, the book will not inspire the student, for though the impressions given furnish some short, neat, and colourful descriptions, they are obviously superficial, being admittedly fleeting views. The personal note is too strongly stressed, and the author's individual predilections, *e.g.* for all pertaining to the theatre, intrude.

The former resident in these lands—if he reads on—will not grow homesick. On the other hand he may desire to fill in the gaps (say, with regard to rubber growing in Malaya): he may wonder how the traveller saw so much beauty in Singapore Harbour and missed that from Penang Hill to Kedah, and why, if the smells from swamp and factories along the road to Seaview and the Swimming Club in Singapore were so unpleasant, the visitor did not use a saloon car and simply close the windows.

Mr. Foran draws attention to the fact that this part of the world, once regarded as far afield from Europe and America and somewhat inaccessible, is now within reach of those who enjoy seeing other scenes and who also wish to travel in comfort. The operation of the international rail route from Singapore to Bangkok, aviation, and other modern developments in Siam, the interest of Sumatra, and the beauties of Bali are well-known facts but not yet common knowledge.

The author is frank in his comments on hotels, the state of the roads, the railways, and on the sights commended to visitors—especially on those in Java.

The personal note, the comparisons made with other parts of the world, above all the inclusion of sections dealing with recent changes, as the rise of Surabaya in Java, and those touching on recent events, such as the chapter on the revolution in Siam, these are appropriate coming from the traveller who has been to the traveller who is going to the countries described. The descriptions prepare the mind and eye. The information given in a single volume is at once more compassable and more attractively presented than in the usual Guide books and pamphlets.

The single map of the F.M.S. Railways is inadequate but the series of photographs is excellent. The simple sketch-maps of the islands in the Dutch East Indies are an asset. They would have been more useful to the prospective traveller if other names of places mentioned in the text had been inserted, *e.g.* Madura, and if the air services had been indicated. I. J. C.

DIE ARBEITERWANDERUNGEN IN SÜDOSTASIEN. By KARL JOSEF PELZER. *Hamburg: Friederichsen, de Gruyter & Co.* 1935. 9×5½ *inches; vi+126 pages; maps.* *M.*3.50

This is an inquiry into one of the most important labour problems of the tropics, which arises in this way. The tropical plantations are large-scale agricultural

enterprises which demand large and fertile spaces of land. These are only to be found in uncultivated districts which cannot supply labour, either white or black. The demand for labour is large because the products—tea, coffee, rubber —need intensive labour. The problem therefore cannot be solved by mechanization, and the demand must be satisfied by importing labour. Response to the demand produces a large, regular, and, because of the nature of the crops, partly seasonal migration.

Dr. Pelzer examines the problem as it affects the five great plantation systems of Assam, Burma, British Malaya, Sumatra, and Ceylon. The labour supply of Assam is drawn from North India, of Sumatra from Java and China, of British Malaya from China and the Madras Presidency. It is remarkable that the Madras Presidency supplies labour for Burma, Malaya, and Ceylon. This is explained by its low standard of life and the superfluous population; as, in general, the migrations are explained by the attraction exercised by high wages and superior standards of life upon overpopulated districts.The yearly average of the total migrations for 1921–30 was 826,400. The size of the migrations is sufficient indeed to influence government policy. The fruitfulness of Dr. Pelzer's researches is shown by the number of questions they suggest: as, for instance, how far do the migrations react upon conditions at home? How far does competition for labour affect costs and influence policy? How large a proportion of the migratory labour settles in the plantations? How far do the mixed populations of the plantations create a new and satisfactory society.

Dr. Pelzer's researches answer six questions: from what districts do the immigrants originate? By what methods are they persuaded to leave their homes? What route do they follow? How large is the immigration into each of the plantation systems? Under what kind of contract do they work? How are they distributed, according to districts and age, sex, and race groups? The importance of his researches is shown by (1) that the problem has, as yet, hardly been investigated; and (2) that the migrations reveal the existence of intense social strains.

Dr. Pelzer's results are based on a study of material in the libraries of the Colonial Office, the India Office, the Royal Empire Society, the British Museum, and the Malayan Information Agency in London, and of the Koloniaal-Institut and Oostkust van Sumatra-Institut in Amsterdam. His book is a model of scientific and significant research and it is to be hoped he will pursue his inquiries further. M. G. R.

THE JOURNAL OF ROBERT STODART: being an account of his experiences as a member of Sir Dodmore Cotton's mission in Persia in 1628–29. With an introduction and notes by Sir E. DENISON ROSS. *London: Luzac & Co.* 1935. 7½×5 *inches; 128 pages; facsimile-map.* 5*s*

Sir Denison Ross has followed up his researches regarding the Sherley brothers by re-discovering and most competently editing the long-forgotten Journal of Robert Stodart. Although Stodart's account of Sir Dodmore Cotton's mission is briefer than that of his fellow Welshman and companion, Thomas Herbert,[1] and has a number of gaps, it enables one to fill in several omissions in Herbert's narrative. It is moreover worth reading for its own sake.

The Journal opens with Stodart's departure from London on 16 April 1626, but the entries cease a few days later, after he had reached Deal. Then ensues a gap of exactly two years. When it recommences, the mission had just reached

[1] 'A Relation of Some Yeares Travaile,' London, 1634 (the latest edition, abridged and carefully annotated by Sir William Foster, appeared in the Broadway Travellers Series in 1928 under the title of 'Travels in Persia, 1627–1629').

Botoon (? Vartān, or, in Isfahani dialect, Vartūn) one stage from Isfahan on the way to Ashraf, whither the Ambassador was going in order to present his letters of credence to Shah 'Abbas. On reaching Ashraf Sir Dodmore Cotton was received by the Shah, who treated him with some civility. Shah 'Abbas appeared nevertheless to take no interest in the main object of the mission, which was to organize trade between England and Persia. What the Shah doubtless wanted was something very different, namely, assistance in the tangible form of men and money against the Turks. Stodart describes how Sir Dodmore and his suite had their food brought to them at Ashraf on dishes of "beaten gould . . . soe big that they were as much as a man could carry from the kiching (*sic*) to the place wher(e) the meate was layde. . . ."

With the mission was the adventurous Sir Robert Sherley, who was returning to the Persian Court after having unsuccessfully sought to induce the Western Powers to combine with Persia against Turkey (Sir Robert had left Persia on this embassy some years before). Sir Robert Sherley met with nothing but rebuffs from the Shah and his ministers, and, soon after arriving at Qazvin (where the mission and the Court had gone from Ashraf) he died, doubtless partly of chagrin. A few days later Sir Robert was followed to the grave by Sir Dodmore Cotton himself. Previous to his death, Sir Dodmore had endeavoured to see the Shah again, but he had been unable to do so. On the Ambassador's demise, the Chaplain, Dr. Henry Gooch, took charge of the mission, and shortly afterwards obtained leave to depart for England. The route taken from Qazvin was *via* Qum, Isfahan, Shiraz and Lar to Gombroon (Bandar 'Abbas), and thence by sea to England *via* Surat and the Cape of Good Hope.

Sir Denison Ross has included in this volume Dr. Gooch's "Relation of Sir D. Cotton's Embassy into Persia" and the "Instructions to the Ambassador," dated 15 April 1626. Sir Denison has displayed much ingenuity in solving the puzzles set by Stodart's extremely defective rendering of Persian names, both of places and persons. The reviewer ventures, with some diffidence, to suggest that "Deh Ochlosuph" (p. 64) may be Deh Oghlu Yusuf, as Stodart himself, after giving the name, says, "W*ch* is in English Joseph" "Botoon" (p. 45) may, as already stated, be Vartān; "Dascherd" (p. 83), a place two stages from Lar according to Stodart, may have been intended for Dastjird or Dastgird, a common place-name in Persia, but no such place can now be traced in this locality. L. L.

AFRICA

ALLGEMEINE LÄNDERKUNDE VON AFRIKA. By FRITZ KLUTE. (Allgemeine Länderkunde der Erdteile . . . selbständige Fortsetzung von H. Wagners Lehrbuch der Geographie. Edited by WILHELM MEINARDIUS. III. Teil.) *Hannover: Hahn* 1935. $9^{1}/_{2} \times 6^{1}/_{2}$ *inches;* viii + 298 *pages; maps. M.*9

This very useful book is vol. 3 of the Series of Continental Geographies edited by Dr. Meinardius. As such, it essays to present a survey of the geography of Africa in all its aspects, so as to serve, presumably, as a work of reference rather than a descriptive geography. And it succeeds admirably, compressing much information into small compass, and maintaining on the whole a well-balanced account. The outstanding characteristic of the book is its clarity, shown both in text and in maps and illustrations. In the text the author's skill in selecting and arranging his material, and his logical orderliness counteract many of the disadvantages inherent to books of the encyclopaedic variety, such as this, while the maps (thirteen in all) are just what the reader feels he needs, being singularly clear in print and containing the amount of detail that is relevant to the point

to be illustrated. They are supplemented in some cases by tables of recent statistics (to 1934) sufficiently simple to be of general use. Here then is a veritable chronicle of facts on which a student may constantly and confidently rely for provision of a solid basis for his other "African" reading. By far the greater part of the book is concerned with the general geography of the continent: the section on climate seems to the reviewer to be admirable in its conciseness and comprehensiveness. Unfortunately the differentiation of sub-regions and the analysis of their characteristics is given much less attention (so that, *e.g.* the analysis of the Congo Basin is restricted to less than three pages, that of the whole of South Africa to four pages), and while it may be argued that the characteristics of such regions are dealt with in the general account, it seems a pity that more use has not been made of the opportunity to assemble the material under regional headings.

The book provides full bibliographies for each section, and there are general indices to place-names and subjects; in short, here is an excellent reference book for students of all kinds and with all objectives. B. H.

NORTH AMERICA

MARITIME TRADE OF WESTERN UNITED STATES. By ELIOT GRINNELL MEARS. *Stanford, California: University Press* (*London: Humphrey Milford*) 1935. 9×6 *inches;* xviii+538 *pages; diagrams and maps.* 18*s*

Professor Mears has more than justified his title by giving a singularly comprehensive survey of the Pacific coast, its maritime trade—past and present—and its future prospects. He is concerned chiefly with the period 1923–34, when maritime trade had adjusted itself to the opening of the Panama Canal and the effects of the war, taking 1930 as his standard year; but he gives brief historical introductions and ample data to substantiate his picture of Pacific coast development and the optimism with which it inspires him.

In his consideration of the Pacific coast, while stressing the great variation in conditions and climate, he is careful to emphasize the importance of regarding the Western states as a geographical entity, whose wealth depends for the moment at least on exploitation of natural resources. This is living on capital, though the population be only thirty to the square mile; but Professor Mears looks to the reconstitution of natural wealth by afforestation, preservation, and economy of resources, and the development of secondary industries to establish a new prosperity on a sounder basis for a vastly increased population. Bulky cargoes and defective rail connections secure to the few but well-developed Pacific ports a stable amount of intercoastal and coastwise trade. More important than this, to the West coast, in view of the rise of the Pacific as the centre of world trade, is the contrast of the civilizations bordering on it. For the future, much depends on the political, social, and economic problems of the East in which, as Professor Mears tersely puts it, China is the passive, and Japan the active factor—European Imperialism accounting for the balance.

Professor Mears discusses Conferences and government subsidies, explaining the paradoxes of merchant shipping. A trade which is basically international lends itself so easily to extremely nationalistic propaganda. When the world is faced with a 30 per cent. surplus of shipping, less favoured nations refuse to admit their disabilities, and impose on themselves great sacrifices to increase the tonnage under their flag. Yet while government regulation seems to be necessary in the intercoastal trade to which nationals only are admitted, the success of Pacific Conferences, in which foreign lines dominate, shows how economic factors can lead not to war, but to co-operation. The Pacific coast has the

advantage over the Atlantic coast, that 80 per cent. of its natural imports happen to be free. A sane plea is made for the extension of the free list, not only in the United States but in other countries as well: ships, however excellent, cannot of themselves create trade. If the plea be granted, the hoped-for increase of world trade may well, after a temporary setback, come about.

Professor Mears has illustrated his careful analysis of trade and shipping movements, in which he has made all allowance for the pitfalls and contradictions of conflicting sets of statistics, by graphs and diagrams that are for the most part excellent. It is however difficult to believe that lists such as those on pp. 142–5 and pp. 355–9 add anything of value to the text. In the bibliography, place as well as date of publication should be given. J. P. H. M.

VOYAGE DANS L'INTÉRIEUR DES ETATS-UNIS ET AU CANADA. By LE COMTE DE COLBERT MAULEVRIER. Edited by GILBERT CHINARD. (Historical Documents. Institut Français de Washington. Cahier VIII.) *Baltimore: The Johns Hopkins Press* (*London: Humphrey Milford*) 1935. $10^{1}/_{2} \times 7^{1}/_{2}$ *inches;* xxiv + 88 *pages; illustrations and maps.* 12*s* 6*d*

Had the editor taken a little more pains he might easily have produced a much better edition of these note-books, which describe this naval lieutenant's wanderings in the country about Philadelphia as well as a trip to Canada in the autumn of 1798. He reached Philadelphia on his return in January 1799. The illustrations are of interest for places in the United States, but none is given of any town in Canada. The author enjoyed this portion of his trip much more than that in the States for the reason no doubt that he spent some time in Montreal and Quebec. At Kingston he came across M. de Puisaye, the French royalist who was taking out a colony to Upper Canada. At Montreal the author was entertained among others by the future hero of Chateaugay; but as the author has never heard of Colonel de Salaberry, he leaves this point unnoticed. He would have done better also to consult a modern gazetteer rather than rely entirely on a French translation of Weld's 'Voyages,' although these were almost contemporary.

The editor might have realized that "out lake" on p. 50 should be "outlet," and that "Mohawe" and "Dock" on p. 55 should be Mohawc and Duck. "La Valtoire" on p. 63 is meant evidently for Lavaltrie. He prints "Sorelle" when the MS. gives it correctly as Sorel; and Chambly becomes Chumbly or Chambley. One is curious to know what can be meant by the "County of Kilmare in England" (p. 10)? There are several errors in the French text which an elementary knowledge of French should have made clear. The illustrations will probably prove of interest to Americans, but the few remarks about the Canadians are certainly valuable and bear out what one learns from other sources. It is curious to notice how thinly populated was then the State of New York.

H. P. B.

AUSTRALASIA AND PACIFIC

A PILGRIM'S WAY IN NEW ZEALAND. By ALAN MULGAN. *London: Oxford University Press* 1935. $9^{1}/_{2} \times 6^{1}/_{2}$ *inches;* xii + 142 *pages; illustrations and sketch-maps.* 12*s* 6*d*

Mr. Alan Mulgan is already well known in New Zealand as one of the more outstanding of the younger writers there. The present book is a complement to 'Home,' which gave a most attractive account of the first impressions made by the mother country on a mind steeped in its history and literature. 'A Pilgrim's Way' undertakes the task of introducing an English visitor to the essential New Zealand. "It is an attempt to paint the landscape of New Zealand and to describe

the community that has been developed in a hundred years of ordered life—both against an historical background—as a visitor might see them under a New Zealander's guidance." The appeal professedly is to the visitor and not to the New Zealander who knows his country, but it will certainly appeal almost as strongly to any other reader. Mr. Mulgan has the historian's perspective of human life and institutions, the artist's appreciation of natural beauty, and the poet's feeling for language. The scope of the work may suggest the guide-book: the treatment makes it literature. If that implied however that the charm of the book derived from its form alone, a grave injustice would be done. The professional geographer, searching for living flesh and blood to clothe the dry bones of his memoirs, statistics, and text-books, will find a rich reward—from end to end the book is the real stuff of geography, and none the worse for being so charmingly written. Thirty full-page illustrations, discriminatingly selected and excellently reproduced, round off a splendid production. R. O. B.

INSECT WONDERS OF AUSTRALIA. By KEITH C. MCKEOWN. *Sydney, Australia: Angus and Robertson* 1935. $7\frac{1}{2} \times 5$ *inches;* xii+252 *pages; illustrations.* 6*s*

AN AVIARY ON THE PLAINS. By HENRY G. LAMOND. *Sydney, Australia: Angus and Robertson* 1934. $7\frac{1}{2} \times 5$ *inches;* viii+228 *pages.* 6*s*

BIRD WONDERS OF AUSTRALIA. By ALEC H. CHISHOLM. *Sydney, Australia: Angus and Robertson* 1935. $7\frac{1}{2} \times 5$ *inches;* xiv+300 *pages; illustrations.* 6*s*

These three volumes all deal with the wild life of Australia and clearly indicate that the people of Australia are beginning to take a much greater interest in the remarkable fauna of that continent.

Up to comparatively recently, most of the literature and investigations into the habits and relations of the animals of Australia were left in the hands of specialists connected with Museums, or a few societies and institutions. Now there are signs of increasing interest in the fauna and its conservation, for already much of the wild life has been seriously diminished and in some cases a few of the rarer birds, especially among the parrots and pigeons, seem to have disappeared altogether.

In contradistinction to Mr. Lamond, Mr. Chisholm is a townsman and well known as a writer on birds. His volume consists of a series of articles, many of them contributed to the Australian newspapers, dealing with different aspects of bird life in Australia.

Two chapters deal with the Satin Bower-bird and the wonderful collection of material gathered to ornament its bower or playhouse; this is of course quite a distinct structure from its nest.

The Lyre-Bird with its extraordinary tail, which is not held upright like a lyre as is generally shown in illustrations, and its beautiful song of which attempts have recently been made to obtain gramophone records and which incidentally is of very great interest for its many primitive anatomical characters, is well described in another chapter, while Cuckoos and their parasitic habits, vanishing flocks of Pigeons, Mutton birds (a kind of Shearwater or Petrel) form the subjects of other articles.

Mr. Lamond sketches bird life on the plains and downs of Western Queensland with a vivid and picturesque pen, and Mr. McKeown, who is the Assistant Entomologist of the Australian Museum at Sydney, draws our attention to the wonders of Australian insect life, ending with a very interesting chapter on the insect food of the aboriginal tribes, a subject about which no general account has yet appeared.

Although of no special geographical interest or significance, we can highly commend these three little books to all who take an interest in the remarkable animal life of Australia. W. L. S.

POLAR REGIONS

SLEDGE: the British Trans-Greenland Expedition, 1934. By MARTIN LINDSAY. *London: Cassell and Co.* 1935. $9\frac{1}{2} \times 6$ *inches;* xii + 342 *pages; illustrations and maps.* 21*s*

This account of the British Trans-Greenland Expedition of 1934, written by its leader, is worth its high price. It is a very human record of the thoughts as well as the doings of the three men who carried out a very ambitious journey almost exactly to plan. Many readers will welcome its style and air of camaraderie, and even those more conservative readers who prefer greater restraint in language and less intimacy between author and reader will admit that it does give a more vivid picture than the formal narratives to which we have been accustomed from earlier expeditions. In certain places however the author shows a most commendable restraint, especially when speaking of the lack of enthusiasm with which his plans were received by many authorities when he was in the throes of raising funds for his expedition. There must now be a mutual recognition of mistakes on both sides. The doubters must admit that their estimate of the leader's ability was at fault, and no doubt he too will realize that there was a certain amount of reason for the lack of enthusiastic support. He can, for instance, understand that if one or two of their narrow shaves had gone the wrong way he would have been held responsible and the people who had vouched for him might perhaps have been called to account. Further, since he has a keen sense of humour, he will forgive some of these doubters for wondering whether he had learnt thoroughly that, for instance, a sledge party is in grave danger if one of its members cuts up the dog food with an axe on a tin of paraffin.

The account runs smoothly and is full of interest, the only possible exception to this being the latter part of the main crossing when, as the author himself states, the daily round had become monotonous to a degree. When events become scarce however he skilfully retains the reader's interest by intimate extracts from the several diaries of the party. Such extracts were freely permitted by the owners of the diaries, but it must be remembered by future leaders that it can only be done in a very small party so closely bound by ties of companionship that mutual criticism can be cheerfully borne. In larger expeditions such a system would probably lead to friction.

An important and useful part of the book is the account of the preparations and of the equipment. Lindsay has learnt very thoroughly from Watkins the importance of attention to detail and, patterning his plans on those either devised or modified by Watkins, he finds very little to criticize about his supplies and material after the journey. He is perhaps a little too severe on the people he likes to call "pre-war polar explorers," especially in the matter of food scales. It is hardly correct to say that "no previous explorer (to Watkins) had realized the necessity of having plenty of fat for hard work in cold weather," since nearly every explorer since Parry had specifically stated the necessity. Lindsay's strictures are the more unnecessary since his own rations for this journey contained a less percentage of fats (36 per cent.) than Scott's Plateau Ration (41 per cent.), and almost the same as Shackleton's ration in 1907 (35 per cent.). The modern rations are certainly a great improvement on the pre-war ones, but it will hardly do to say that "the old school of sledgers took scarcely any fat." His scorn for

biscuits also needs some modification, since he took about 8 ozs. of other carbohydrates to make up, such as oats, pea-flour, etc. These were not taken on earlier expeditions since paraffin had to be economized. Probably the most useful change in the quantities now taken is in the paraffin. Scott's ration was not quite ½ oz. per day per man, Watkins' for winter journeys was rather more than twice that amount. Many a "pre-war sledger" will be envious at the sentence "it was always necessary to burn the Primus for an hour or two after supper," but should admit too that he might have been more efficient himself if he had increased his paraffin.

The appendices to the book are really useful since they give in a shortened form a maximum of the scientific results in a short space. The discussion of the topographical conclusions is interesting and the careful calculation of altitudes is as thorough as space permits. It is very clear that the party not only did their best to make the survey a good one, but can now be regarded as authorities on what to do and what not to do in a running traverse on a plateau. With reference to the party's difficulties over gloves suitable for theodolite work, it might be suggested that the old-time method of using cat-skin gloves, with thumb and forefinger separate and fur outside, would solve this problem. It would at all events be simpler than the suggestion, given in the appendix, of a combination of a pair of airman's silk under-gloves covered by a pair of chamois gloves covered by a pair of mittens. Special mention should be made of the appendix on equipment, which should be a useful guide for future small expeditions.

Croft's photographs are excellent and the map drawn by the draughtsmen of the Royal Geographical Society from Godfrey's survey work is, as far as one can perceive, an excellent piece of work for such conditions. Finally, Lindsay has done a service in stating clearly what it has all cost. An 1100-miles' sledge journey, another crossing of Greenland, 300 miles of newly discovered country surveyed, and last, but not least, two more experts at polar travel, and all for £1400. F. D.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

A NATURAL HISTORY OF THE SEAS. By E. G. Boulenger. *London: Duckworth* 1935. 8½×5½ *inches; 216 pages; illustrations. 7s 6d*

On the cover of this book the publishers claim that it makes available to the general reader the advances made in oceanography during the past twenty years. Were this the case it would indeed be of interest to geographers. It is true that it contains some account of the life-history of the eel, already well known, and descriptions of the deep-sea angler fishes with their parasitic males, both of these the outcome of Professor Schmidt's expeditions, while there are some references to recent work on plankton. But the great bulk of the information the book contains was known, and available to the general public, a generation ago.

Mr. Boulenger gives a general account of the inhabitants of the sea taking these group by group, from the Protozoa to the Mammals, and concluding with the usual chapter on the sea serpent and allied monsters. The facts recorded are in the main correct although there are occasional lapses, notably in physiological matters, while geographers will observe with dismay that the author has committed the old fault of confusing the coral atoll of Cocos-Keeling in the Indian Ocean with Cocos Island in the south-eastern North Pacific. But it is in the main no more than a collection of facts, many of them interesting enough in themselves, concerning the inhabitants of the sea. The really significant recent advances in oceanography are those which reveal the essential unity of the

marine community. This is the result of the co-ordinated work of biologists, chemists, and physicists on the nature of the marine environment, the influence of this on the plants and animals and the interactions of these the one on the other. The presence of dissolved inorganic salts, minute in amount in given water samples, controls the fertility of the sea over vast areas; minute changes in salinity or temperature control the breeding and distribution of innumerable organisms; water currents, the movement of which is barely perceptible, make life possible in regions which would otherwise be desert.

This book will be of interest to the amateur in Natural History; it is adequately illustrated, the photographs being better than the drawings which illustrate the text, many of the latter being unduly stiff, but there is little in it to attract the attention of those interested in the wider aspects of oceanography. C. M. Y.

HALF MILE DOWN. By WILLIAM BEEBE. *London: John Lane* 1935. $9\frac{1}{2} \times 6$ *inches;* xx+344 *pages; illustrations and sketch-map.* 18*s*

One of the greatest achievements in the science of Oceanography during the nineteenth century was the discovery that life is present even in the greatest depths of the sea. Edward Forbes when, in the year 1854, the world was robbed of his genius at the early age of thirty-nine, believed, and for apparently sound reasons, that the 300-fathom line represented the effective limit of life. He referred to the animals taken at these depths as being "like the few stray bodies of strange red men, which tradition reports to have been washed up on the shores of the Old World before the discovery of the New, and which served to indicate the existence of unexplored realms inhabited by unknown races, but not to supply information about their character, habits, and extent."

The raising of a broken telegraph cable from a depth of 1200 fathoms in the Mediterranean, a bare six years after Forbes' death, put a different complexion on matters. It was found covered with encrusting life of different kinds. It was left for Wyville Thomson, W. B. Carpenter, and Gwyn Jeffreys in their cruises during the years 1868 to 1870 in H.M.S. *Lightning* and H.M.S. *Porcupine* to prove, beyond all manner of doubt, that in the North Atlantic life is relatively abundant to depths of at least 2500 fathoms. The work of the *Challenger* Expedition revealed that this held good for every ocean and every depth.

Since that time numerous other deep-sea expeditions have made countless hauls with dredge and trawl in the great depths of the ocean. We know a great deal about the animals which live there and, from their form, can conjecture more about their habits when living. The work of Sir John Murray has revealed the nature and origin of the deposits on and in which they live; the reversing thermometer and the water-bottle have revealed the physical and chemical properties of the water at all depths. We have probably acquired a very true picture of the nature of this submarine realm and of the character, habits, and distribution of its inhabitants.

But it is a very different story when we consider the middle depths of the ocean. We may drag a net over the surface of the bottom and collect a very representative sample of the life present. Nets drawn through the middle depths, inhabited by animals all highly adapted for rapid movement, are much less successful. To take but one instance, there are a number of species of giant squid which live in these regions. To the best of the reviewer's knowledge none has ever been captured in a net. We know of their existence from odd specimens which have from time to time been washed up and, above all, from the work of the late Prince of Monaco who sought for them in the stomachs of sperm whales which feed upon them after titanic battles recorded by sucker marks and scars on the bodies of captured animals.

It is the distinction of Dr. W. Beebe and Mr. Otis Barton to have been the first human beings to set eyes on the inhabitants of the middle depths of the ocean in their native haunts. This they have accomplished by descents in the "bathysphere," designed by Mr. Barton and named by Dr. Beebe, to a maximum depth of 3028 feet. This is a spherical steel diving chamber, 4 feet 9 inches in diameter, 5000 lb. in weight, fitted with a door weighing 400 lb. and secured by ten large bolts and with a wing-bolt plug in the centre. It is fitted for three windows, though only two have actually been used, of fused quartz, 8 inches in diameter and 3 inches thick. An electric cable, specially designed for the purpose, carries telephonic and power wires, the former for maintaining contact with the operators at the surface, the latter for supplying current to the spot-light used to illuminate the water at great depths. Existence was made possible by oxygen cylinders, and trays of soda lime and calcium chloride for absorbing carbon dioxide and water vapour respectively. The bathysphere was lowered by means of 7/8-inch non-spinning steel cable attached to a 7-ton winch previously used by Dr. Beebe in the *Arcturus* Expedition. All this gear was carried on a lighter which was towed by a tug, and all operations were carried out between 6 and 12 miles to the east of Bermuda during the years 1930, 1932, and 1934.

Dr. Beebe prefaces his book, which is essentially an account of his experiences in the bathysphere, with an account of early divers and of what he terms "proto-bathyspheres." He retells, with effect, the legend of Alexander the Great's descent into the sea based on the Ethiopic version of "Pseudo-Callisthenes." The account of the proto-bathyspheres, which is admirably illustrated with reproductions from old prints, is a record of imaginative ingenuity rather than technical success, as few of the strange appliances described appear to have reached even the experimental stage.

Dr. Beebe brings his account of the history to a date just before the attainment of practical success. We are left in the dark as to the exact stages which preceded the development of the modern diving dress. A history of the diving helmet, especially in its application to marine research, would have been apposite, especially as one chapter deals with Dr. Beebe's own experiences with this invaluable appliance. So far as the reviewer is aware it was Dr. A. G. Mayor, Director of the Department of Marine Biology of the Carnegie Institution of Washington, who first made extensive use of it as an aid to biology, Mr. John Mills, his engineer, having previously developed it at Miami.

Dr. Beebe's accounts of the descents in the bathysphere, though they suffer from excessive repetition, while the chapter on the Bathysphere Broadcast might suitably have been omitted, are lucid and graphic. He is a naturalist, a born observer who has developed his gifts to the utmost by a lifetime in the field, and as such admirably fitted for recording the brief, often fragmentary, glimpses of fish, crustaceans, and other marine creatures which passed through the limited field of vision from the windows of the bathysphere during the necessarily brief period of the descents. He had moreover the great advantage of several years' previous investigation of the deep-sea fauna off Bermuda.

It is this aspect of these profound dives that is the most important. Samples tell us all we need to know of physical and chemical conditions at these depths, while the rapid development of technique for studying the penetration of light into water will soon provide abundant and exact information on this score. It is interesting however to have the evidence of the human eye in this matter and Dr. Beebe's account of how, in turn, the red, orange, yellow, green, and blue light vanish leaving only a trace of violet which gives the impression of a cold, whitish-grey before all trace of light disappears at about 2000 feet, makes fascinating reading. His greatest contribution to knowledge is undoubtedly his descriptions

of these preposterous deep-sea fish with rows of lights like the illuminated portholes of a liner at night, which vanish as their owner enters the beam from the spot-light to reappear as they leave it, of others in which the light is under control and appears and disappears at will, of the deep-sea prawns which discharge spurts of luminous material with the effect of an explosion. Some interesting records were made of the depth to which fish, hitherto regarded as surface forms, can penetrate. Dr. Beebe records, with a surprise that the reviewer cannot share, the fact that the population at these depths is more numerous and its components larger than is indicated by the contents of nets dragged at these depths.

This raises the problem of more efficient means of capturing these animals. Human ingenuity must devise some new method; the use of giant traps suitably baited with widely open doors that can be shut by messengers sent from the surface seems a possibility. Better still would be a trap which could be operated from the bathysphere. Dr. Beebe has been courageous enough to name a certain number of the fish seen for the first time through the windows of the bathysphere; but what does the systematist think of a species the type-specimen of which is swimming about half a mile below the surface instead of reposing in spirit in the vaults of a museum?

A further indication of the possibilities of the bathysphere is indicated by Dr. Beebe's account of his all-too-brief attempts at "contour diving." Systematically pursued this would supply us with much-needed knowledge of the depth to which the more conspicuous bottom-living animals—reef-building corals and their allies in particular—descend. Such animals are excessively difficult to dredge owing to their size and attachment, and exact knowledge of their vertical distribution is needed for the full elucidation of the coral reef problem.

Dr. Beebe concludes his book with a series of technical appendices. These are useful in themselves and also as a corrective to the, at times excessively, subjective aspect of the preceding chapters. But the book as a whole is a tribute to the inventive skill of Mr. Barton and to the remarkable powers of observation of Dr. Beebe. C. M. Y.

PROBLEMS IN SOIL MICROBIOLOGY. By D. WARD CUTLER and LETTICE M. CRUMP. (The Rothamsted Monographs on Agricultural Science. Edited by Sir E. JOHN RUSSELL.) *London: Longmans, Green & Co.* 1935. 9×5½ *inches;* viii+104 *pages; map and diagrams.* 9*s*

In rain or shine, heat or cold, the soil remains comparatively tranquil, supporting its teeming population of organisms and providing for them a perfect medium for their activities, sheltered from the changes and chances of the outside world. On this population of micro-organisms all higher life depends. Problems connected with soil microbiology therefore are of fundamental importance, and the present volume, which is based on a series of lectures delivered at Aberystwyth in 1934–35, is a welcome addition to the literature of the subject. It consists largely of the description of experimental work carried out at Rothamsted and is therefore not intended to be a complete text-book of the subject, but aims rather at summarizing the results of recent researches.

After a preliminary chapter on the general suitability of the soil as a medium for microbiological growth, the authors describe recent work under the headings of "Bacterial Populations under Field Conditions," in which methods of counting populations and the causes of fluctuation in numbers are dealt with; "The Relation of Bacteria to Nitrite," which emphasizes the capacity of nearly all species to affect the nitrite part of the nitrogen cycle; "Carbon Dioxide Produc-

tion by Soil," where methods of estimating the production of carbon-dioxide as a measure of microbiological activity are described; "The Growth of Protozoa in Pure Culture, and their Behaviour in the Soil," which summarizes the latest conclusions on the fascinating subject of the innate rhythmical behaviour of protoplasm; and finally "The Inter-action between Soil Organisms," which deals with the factors which affect the composition of the soil population.

A bibliography and an index complete the volume, which is illustrated by diagrams and a map showing the world distribution of soil protozoa, compiled from the results of soil-analyses at Rothamsted. The book is written in a way that should stimulate further work on the same lines and will certainly be welcomed as a summary of the existing state of knowledge in an important and rapidly developing branch of biology. J. S. L. G.

CARTOGRAPHY

MAP OF BRITAIN IN THE DARK AGES. *Southampton: Ordnance Office* 1935. 39 *pages; map scale* 1 : 1 *million.* 5*s*

This is the third of the series of Period Maps of England and Wales issued by the Ordnance Survey. Like its predecessors it gives to the historical geographer "possession of the essential facts in a convenient cartographic form." As they have become standard works, so this likewise promises to become the basis of future discussion about the geographical issues involved in the early Anglo-Saxon settlement, and in the contemporary Celtic west. As the first comprehensive "picture of the Dark Ages," and as an authoritative summary of the reliable evidence, its importance needs no further emphasis.

The problems involved in the reconstruction of this map must have been more difficult than in the case of its two predecessors. The one required the plotting of authenticated Roman remains; the other required a rigorous selection of the seventeenth century evidence. Both earlier maps had the advantage of dealing, in a sense, with more manageable periods and materials. But the Anglo-Saxon period is different. Its initial date is easy enough to determine—A.D. 410, the year of the "departure of the Romans." There was however a Roman legacy, and, at first sight, one of the most striking features of this present map is the absence of Roman roads. Only those supported by substantial documentary evidence have been inserted, and they number but three stretches. For a terminal date, the year of the accession of Alfred the Great (A.D. 871) has been chosen, but the map omits "a few Danish sites falling between 800 and 871, and all Norse river-names." The Preface also declares that sources dating from after 871 have only been used in so far as they appear to be based upon earlier texts or to represent a genuine tradition. But we are promised a later map of the period 871–1066, on which the roads of the Saxon period as well as the later evidence will be shown.

Despite these intentional limitations, quite enough problems remain. The years between A.D. 410 and 870 were full and varied, marked by "a pagan period of invasion and settlement, followed, in the seventh and early eighth centuries, by an outburst of cultural and political vigour." Thus it is that pagan cemeteries of the one phase appear intermixed with churches and crosses of the other; while there are place-names of both periods. Partly for this reason, the map requires more reading than do the other two; and it probably needs a more specialized background for the ready appreciation of its problems. The main map is supplemented by two outline maps included in the Introduction. These are a most welcome feature. One shows the distribution of early place-names in -ing, on the basis of Professor Eilert Ekwall's well-known study (Lund, 1923). The other

shows the distribution of cemeteries. These maps provide a clear basis for a discussion of the extent to which the two distributions correspond. The available material is certainly presented in a clear manner, and it seems that this practice of including outline distributions could be extended to other evidence. A number of similar outline maps would certainly do much to display the problems of the main map more clearly.

The array of evidence has been plotted against the same forest background as that adopted for the second edition of the map of Roman Britain. This was based upon geological evidence. We are assured that it is unlikely that any considerable areas had been cleared by 871. In the absence of a large body of detailed and exact evidence relating to clearing during these centuries, this Roman forest cover is very helpful; but, of course, by Domesday times it is certainly evident that geological possibilities do not provide in themselves a complete explanation of the distribution of woodland, and it may be that some of the Domesday evidence has a retrospective value extending back beyond 200 years.

Particular mention must be made of the dual character of the map—Celtic as well as Anglo-Saxon. In each case the evidence, both archaeological and documentary, could have been assembled only through the assistance of a large number of scholars. Mr. O. G. S. Crawford is to be congratulated upon his synthesis of the widely spread material for a period that is perhaps as difficult as any and more difficult than most. The result of the synthesis is a map indispensable to every student of English historical geography. H. C. D.

ECONOMIC AND HISTORICAL GEOGRAPHY

THE WORLD IN OUTLINE. By E. D. Laborde. *Cambridge: University Press* 1935. 8×5 *inches;* viii+536 *pages; illustrations and maps.* 6*s* 6*d*

"Teachers—and examiners (writes Mr. Laborde) are not infrequently puzzled by the cryptic phrase 'the world in outline' which occurs in the syllabuses of some examining bodies." He has therefore written a text-book with the title in question designed to solve this problem. Coming from so practised a pen, well printed, well planned, and excellently illustrated, this book is assured of a welcome in secondary schools, and the reviewer can therefore take the opportunity of discussing the problem which (in common with other first-rate school books) it raises in an acute form. This is the problem of geographical terminology. In his desire to simplify the subject, the schoolmaster-author frequently introduces terms which are either entirely novel or are incorrect. In either case the pupil is likely to be penalised in the examination room. Examples taken at random from the book under review are "Atlantic Mountains" represented as running from about 35° N. into Labrador, "parkland" as the natural vegetation of the Appalachian Belt, "Pontic type" as the climate of the Russian grasslands, and "roestone" as the designation of the whole series of rocks which build the Cotswolds and the Côtes de Meuse. The attempt to deal with structure and landforms when neither teacher nor taught has had any training in elementary geology is also to be deprecated. Here the solution is perhaps to be found not in excluding a topic of great interest and value, but in letting geology take its place with chemistry and physics as one of the sciences to which the adolescent should be introduced. Examples of misleading or faulty statements for which Mr. Laborde is responsible are "the ice has dug hollows" "the ice cap . . . lay over it during the Tertiary Age" (p. 270), and "when the ice began to melt, the streams issuing from it laid down a thick film of rich black earth, known as *tchernoziom* in southern Russia" (p. 5). Climate is another stumbling-block in the school text-book. It is quite impossible to explain Bjerknes' theory of the

cyclone in a dozen lines, and by the use of such phrases as "a kink forms in the line of separation." The writer continues: "Wherever the warm, moist, equatorial air touches the cold polar air, condensation follows," again introducing error by over-simplification. In the reviewer's opinion, climate teaching at the school stage should be mainly descriptive, and only in the broadest sense explanatory. Mr. Laborde's book contains plenty of good climate maps upon which careful descriptions may be based, and it is indeed only rarely that he stumbles into the pitfall of using vague qualitative terms. An examiner would probably be very severe with a candidate who described the Basin of Aquitaine as "mild and damp" (p. 24) with "in consequence" such crops as wheat, maize, and the vine. On another page (513) we learn that maize requires "heat, moderate rain," and that its "habitat" (again a misuse of terminology) is United States, Hungary, India. As one of those concerned in the framing of syllabuses, the reviewer can say with confidence that under the heading "the world in outline" it is expected and intended that attention shall be given to the world as a unit, and to world distributions of every kind. Mr. Laborde has not included a single world map, and his book must be regarded (in spite of the criticisms made above) as a really good regional geography of the continents rather than as a geography of the world in outline. E. G. R. T.

GENERAL

CANOE ERRANT. By Major R. RAVEN-HART. *London: John Murray* 1935. 8×5 *inches; illustrations and map.* 7*s* 6*d*

During the last few years travel in collapsible canoes on the Mid-European waterways has ceased to be the insanity of a foolhardy few and has become the accepted holiday of many. Some hundreds of Englishmen, mostly of the undergraduate and post-undergraduate age, spend a fortnight on the Danube every year. They find there forgetfulness of office life, and a ridiculously cheap form of unusual foreign travel.

Major Raven-Hart is the greatest British authority on—and apostle of—the new sport. He has descended an almost unbelievable number of rivers in France, Mid-Europe, and the Balkans, and in 'Canoe Errant' he has captured something of the happy, vagrant river life that has meant so much to him during the last five years. Of fast water canoeing, especially of canoeing as a rather risky adventure, he deliberately does not choose to write. There are rivers, he says, which "are as dangerous as many mountain peaks," and he leaves it at that.

'Canoe Errant' deals briefly and pleasantly with each of the author's many journeyings. It contains sketches of companions, of nights spent at canoe stations, of days of exhilarating travel beneath warm suns. It is also an authoritative work, crammed with practical advice concerning ways and means. It is a reference book as well as a masterpiece of propaganda and he is not wise who, planning such a holiday, neglects to read it or to take it with him. Dealing, as Major Raven-Hart does, with so many journeys similar in type, he cannot altogether avoid a certain repetition of atmosphere and just the faintest tendency to "Guide-Book," but these slight weaknesses are almost inevitable. They do not prevent 'Canoe Errant' from being a most readable as well as an important book. K. C. G. D.

THE DEATH OF HIS MAJESTY KING GEORGE THE FIFTH AND ACCESSION OF HIS MAJESTY KING EDWARD THE EIGHTH

At the opening of the Evening Meeting of the Society on 3 February 1936 the President read to the Fellows the Letter of Condolence and Congratulation addressed to H.M. King Edward the Eighth and the Letter of Condolence with H.M. Queen Mary, resolved upon at a special meeting of the Council held on 23 January 1936, as follows:

TO HIS MOST EXCELLENT MAJESTY KING EDWARD THE EIGHTH

MAY IT PLEASE YOUR MAJESTY

We the President and Council of the Royal Geographical Society, in the name of its Fellows, beg leave to approach Your Majesty with this expression of our great sorrow at the death of His late Majesty King George, Patron of our Society. For many years before He succeeded to the Throne, and throughout His beneficent reign, He graciously bestowed upon our Society the marks of His royal favour, to the great encouragement of our Fellows in their distant explorations and in their labours at home for the advancement of geographical science. In dutiful remembrance of His benevolence, and in humble gratitude for the wisdom of His rule, we would ask that the Fellows of our Society be counted among the most loving of His subjects in mourning His death.

We now crave Your gracious permission to perform a second and a joyful duty in tendering to Your Majesty our loyal congratulations at the moment when it has pleased God to bring You in the fullness of strength to the throne of Your ancestors. We pray for Your Majesty's long life and abiding happiness in the affection of Your subjects and the prosperity of the Realm.

In a Special Meeting of the Council at the House of the Royal Geographical Society in Kensington Gore this 23rd day of January 1936.

ARTHUR R. HINKS

P. Z. COX
President
HOWARD OF PENRITH
W. L. SCLATER

TO HER MAJESTY QUEEN MARY

MAY IT PLEASE YOUR MAJESTY

In the hour when our nation and the whole world mourn a beloved King, we the President Council and Fellows of the Royal Geographical Society beg leave to offer Your Majesty our most respectful homage and sympathy, praying that You may have strength to support the sorrow which the death of our Sovereign has laid upon You, and in full assurance that Your Majesty will find comfort in the loyal devotion which His subjects bear to Your Son on His Accession.

At a Special Meeting of the Council of the Society to which You have graciously given Your Patronage we crave Your Majesty's permission to subscribe ourselves Your devoted servants

From the House of the Royal Geographical Society in Kensington Gore the 23rd day of January 1936.

ARTHUR R. HINKS

P. Z. COX
President
HOWARD OF PENRITH
W. L. SCLATER

ARABIAN ADVENTURE

Lieut. J. M. Sinclair, R.A., has sent the following interesting notes and reminiscences to the Society:

"I have read with interest 'Arabian Adventure,' by Douglas Carruthers, and the review which appeared in the *Journal* for November last. On p. 137 of the former is written, apropos of Bayir, that it is 'a present-day outpost of the Trans-Jordan Frontier Force.' I was the officer in charge of the first post established there, and, in addition, I have frequently visited Hausa and Jebel Tubaiq. It appears from the book and is apparent also in the country that the oryx and ostrich are rare and rapidly dying out. I have seen both, and therefore, although I am no naturalist, my experiences may prove of interest.

"Bayir contains not two wells but three. There is one, reputed to belong to the Beni Sakhr, about a quarter of a mile down the wadi from the ruin, under which lie the other two. This ruin no longer exists. It is part of the vandalism of our methods that it was destroyed to provide stone for the police post above the wells. In order to save a few piastres, an interesting relic has been wantonly pulled down. About a mile down the wadi bed from the wells is a reservoir, built on the same lines as that at Ziza, but smaller. Two conduits lead into it, and there is also a stone-lined well. The latter is filled in, but the rope marks still exist in the stone. This reservoir is reputed to be Roman. The ancestral tomb of the Beni Sakhr I never saw, and so can only surmise that the tradition has died out, for, although there are many tombs and cairns, there is none that answers its description. It would be interesting to know if the murder of Auda abu Tayy's eldest son by the Beni Sakhr, as related in the 'Seven Pillars of Wisdom,' was the cause of this lapse.

"Mention of Abu Tayy brings to mind an amusing experience I had whilst patrolling the Ardh es Suwan to the east of Bayir. I was protecting the Tuweiha Howeitat, based on Bayir, and had limited them to an area bounded by the Wadi Charra and the Waqf es Suwan, a radius of some 20 miles from the wells. To assist me in confining the grazing parties to this area I had one aeroplane. The time was late October, but no rain had as yet come. One day I received confirmed information that a raid was assembling at Jauf with my tribes as the objective. I decided to close the camels temporarily on Bayir, and disposed my force to ensure the capture of this raiding party. Of course the tribes demurred, but eventually acceded, and next day they reported all their camels in. Neither our patrols nor air reconnaissance found any delinquents. I next wished to send out a Bedu patrol to obtain information. My choice fell on Humeida abu Tayy, second son of Auda, intelligent and bold. He was willing, but at the meeting I called to explain my intentions, the sheikhs proved antagonistic. The conversation, according to custom, turned to many subjects, among them the weather. When, they asked, would the rains come? Exasperated, I replied that they would come when my wishes were fulfilled. This apparently had the desired effect, for off Humeida went that afternoon. That very evening an unexpected storm arose: thunder and lightning were continuous; the rain poured down in torrents: my tent was blown flat. During this storm I received a report from my outpost on Metaha Bayir that a shepherd had come in with the news that his camels had been raided. He proved to have been in the Wadi Hasa, some 15 miles beyond the Charra. The aeroplane had failed to spot him. My wireless would not work on account of atmospherics, but I took what steps I could in the forlorn and, as it proved, unsuccessful attempt to cut off the raid, and then went to the sheikhs. I reminded them of my answer about the rain, rubbing it well in, and also told them exactly what I thought of them for allowing me to miss the raid. They were crestfallen and treated me almost

with awe, and ever after my inspired and unpremeditated prophecy assisted me in all my dealings with the normally highly suspicious Bedouin. The Wadyan on the Ardh es Suwan as shown on the map are slightly inaccurate, but that is a minor detail. What is satisfactory is to see place-names spelt as they should be. The R.A.F. insisted on calling Thulaithukhwat (the Three Sisters) Thlatwat, which means nothing, and if used to Bedouin produces, of course, a look of blank astonishment on their faces. This and similar atrocities in nomenclature were perpetrated, but in making our map I was outvoted, and my pleadings for a rational transliteration were in vain.

"One of the most interesting and, let it be confessed, terrifying formations east of the Hejaz railway is the Jebel Tubaiq. It is, to my mind, a continuation of the Rumm Mountains, without their grandeur. But it is sinister. In 1930 it was still the refuge of delinquent tribes, and it was long before we could penetrate its fastnesses with our vehicles. Had the author approached Hausa on a more westerly route, say from Gharamil, he would have seen a view which would defy even his powers of description. First, in the far distance, appears a faint pink line. Gradually, as you approach, the colour deepens and takes on a ruddier hue. Finally you drop down into Al Qaara, which we knew as As Sahb, and which appears a few hundred yards across and is actually a couple of miles, and the full magnificence of Tubaiq (for I hold Hausa to be part of Tubaiq) is upon you. Hills are fantastically eroded—one, Ruqubba, looks like York Minster —and they vary in colour from red to black. The view of the Rumm area from the top of the Negb Esthar is the only one that rivals it in the country, and that view is unique. 'Saba Biyar' must be my Beni Murra wells. There were seven of them, but they were filled in. I would be interested to know if they were open in 1909. Al Qaara does not drain to Al Jafr. There is a watershed between the two, and it winds eastwards to the Wadi Sirhan. I penetrated almost to Banat al Baqr, country which owing to sand is not suitable for movement in cars. Al Bisaita and the Nafud I never saw, to my regret.

"I only saw the Arabian ostrich twice. On the first occasion I was based on Hausa, and was doing an air reconnaissance over Tubaiq. This was in 1930. On our return the pilot suddenly dived into a wadi. When I had recovered, I saw what I took to be a Bedu in his brown and white aba running for his life. I then realized that he was running far faster than any Bedu I had yet met and that it was an ostrich. It was in a wadi about a mile east of Hausa wells. On the second occasion I was in charge of the frontier patrols between Hausa and the Wadi Bayir. This was in 1931, and by then I knew every inch of the country. One day I was motoring down the frontier, and had reached the Wadi Hedrij, when I saw a bush on top of a slight eminence about a mile away where no bush had been before. We stopped and I asked my driver what he thought it was. He, seeing nothing unusual, replied 'A bush.' Not satisfied, I drove up, and when I got within 50 yards the 'bush' lifted its head and ran off. I paced this ostrich at 32 miles an hour. This experience, to my mind, vindicates the story of the ostrich burying its head in the sand. I am certain that that ostrich, which could see me long before I saw it, instinctively put its head on the ground to simulate a bush and, if I had not known the desert well, the ostrich would have succeeded and remained undisturbed.

"The Arabian Oryx I only saw once, on 1 January 1931. I was on an operation, and travelling as fast as I could to close the southern exits from Jebel Tubaiq. As my column was passing up the Wadi Taraif, I saw this oryx some 500 yards away. There was no mistaking the large whitish creature. Unfortunately I had not the time to investigate. There was a herd of some eight head left in Tubaiq itself, otherwise I believe they have fled the country. The R.A.F. got

one there, and the head is in their mess at Amman. It was nearly a record, and the measurements are kept by Rowland Ward, who mounted it.

"Game, and particularly the larger varieties, are undoubtedly being slowly ousted from their old haunts. Even the gazelle, most graceful of all, is fast becoming rare. I have seen herds of fifty: now ten is surprising. The Bedouin know no close season, and I am afraid that in Trans-Jordan some of the British are not a pattern to guide them in this respect. Unless action is taken soon to prevent promiscuous and wasteful shooting and to place the preservation of game on an organized footing, there will be nothing left. Can no action be taken, or must the oryx and the ostrich, and in time the gazelle, follow the lion and the wild ass into Arabian history? Why not turn the Jebel Tubaiq, the home of most of the wild life of Trans-Jordan, into a game reserve? It is not an impossibility."

DESICCATION IN THE SUDAN

There is a strong belief that many of the more arid parts of Africa are steadily drying up through the spread of desert conditions, and that human agency rather than climate is the determining factor in the process. In an article entitled "Desiccation or Destruction," published in *Sudan Notes and Records* (vol. 18, Part 1, 1935), Mr. A. E. Robinson argues on these lines regarding the Sudan and Egypt. He shows that there has been a decided expansion of the desert in the Nile Valley, and that many areas abandoned by sedentary populations to camel-owning nomads have become desert in modern times. The main cause of the desiccation he considers to be interference with vegetation either through destruction of forests or neglect of cultivated land on account of water supply difficulties during spells of diminished rainfall or from other causes. Much historical and archaeological evidence is adduced to indicate the pernicious results that have followed such destruction or neglect by man. In regions of low rainfall deforestation and the subsequent abandonment of sites on which the flora depended upon man for water quickly causes land to revert to or become desert. The surface soil becomes disintegrated where the herbage is sparse or dead, and the wind then blows the fertile soil away since there is nothing to bind it. Drifting sand is then liable to invade the abandoned areas, particularly after a run of dry years, and so new desert tracts are formed. This appears to have happened to a marked extent in the Isle of Merōé in the Sudan. In Lower Egypt great increase in the desert areas since Roman times has been attributed to the unrestricted immigration of camel-owning nomads with goats who displaced the agriculturalists by destroying the pastures where the sheep and cattle grazed. Camels and goats are stated to tear out vegetation by the roots and thus loosen the fertile soil, which is blown away from the land.

Mr. Robinson quotes the findings of the South African Drought Commission of 1923 that: "There is no evidence for any progressive increase or decrease in the rainfall of the Union during the historic period. The desiccation observable in many parts of the country is due not to diminished rainfall but to the failure of the land to absorb the rain as it falls, consequent on the destruction of the natural vegetation, the resulting erosion of the soil, and the hardening of the surface of the land by sun-baking and trampling of cattle." This appears to be the general verdict all over the Continent, that no change of climate is in progress, but that normally recurrent dry spells take advantage of faulty utilization of land. It may be recalled that in Australia E. T. Quayle has demonstrated a perceptible increase in rainfall following cultivation (*Geogr. J.*, vol. 61, p. 64).

A NEW MATERIAL FOR GEOGRAPHERS

A new material has been put on the market under the name Correctostat. A process has been devised whereby a fine-grade paper adheres to each side of a sheet of aluminium foil, the total thickness of the metal and the two layers of paper being about 1/40 mm. Although primarily manufactured as a photographic material for use when making the prints used in photographic surveys, the material is of value in the drawing office or in the field, on account of its quality of keeping scale. Some tests were recently made in the Society's House to discover its behaviour under extreme physical and chemical conditions. It was found that when once bent the paper could not be straightened again; but it remained unharmed when made into a roll of about 7 cm. diameter, and could therefore be carried in the ordinary traveller's chart cylinder. A measured length was raised to about 140° F. and measured again at that temperature; any change in length was less than 1/10 mm. in a length of 60 cm. Usually a moist, salt-water laden atmosphere causes corrosion in aluminium, so a test was made in boiling brine. A piece was frayed, with difficulty, at the edges so as to expose the bare metal and then left to boil for twenty-four hours. The adhesion of the paper to the metal remained constant during the test and after drying no change was noticeable.

The paper used for the non-sensitized Correctostat is a first-quality machine-surfaced paper on which the Society's draughtsmen have reported very favourably. The paper takes pencil and ink well and is not impaired by the use of indiarubber or knife-eraser. It seems to be a material that may turn out to be very useful both on a plane-table in the field and for the preparation of plans in the drawing office. At present it is manufactured only by the German firm Agfa at the high price of 12*s* 10*d* per square metre. It is to be hoped that a British firm will some day provide geographers with such a very useful material at a more moderate price. M. A. S.

THE EQUATORIAL RAIN-BELT

In the *Geographical Review* for October 1935 Dr. John Leighly, of the University of California, in an article entitled "Continental Precipitation on a Rotating Earth" attempts a simple explanation of the very involved question why the equatorial rain-belt goes through so limited a swing in comparison with the range of the vertical sun through 47 degrees of latitude. The argument is briefly as follows: Over the tropical portions of the continents the distribution of rainfall is called "continental" in the sense that there is no regular decrease inwards from the coasts, the reason being that moisture-laden air currents are able to penetrate the interior freely. Over the extra-tropical portions of the continents, on the other hand, the distribution of rainfall is called "peripheral," since it decreases (allowance being made for relief) fairly regularly with distance from the sea. In this case the moist maritime winds are alleged to be deflected by the Earth's rotation so as to circulate round the continents in summer without penetrating the interior. Now it happens that over the tropical continents rainfall begins to show a marked decrease between latitudes 17° and 20° N. and S., which are also the latitudes where the deflective force due to rotation commences to be operative. In this coincidence the author sees the reason why the doldrums do not follow the sun to the tropics of Cancer and Capricorn: the moisture-laden air currents are cut off in the higher latitudes. Consequently he thinks the traditional explanation that the equatorial rains are due to heat convection involving a lag behind the vertical sun is at fault.

The facts however upon which Dr. Leighly's theory is based are not entirely as represented; nor can it be conceded, when regard is paid to the distribution

of pressure and related winds, that deflective force has much bearing upon the question. The author gives no recognition whatever to the determining factor in the convectional equatorial rains, namely the convergence of air currents from the N.E. and S.E. Trade systems. In the case of Africa the association of the mean monthly rainfall with convergent stream-lines has been shown by Brooks and Mirrlees (*Met. Off. Geophys. Mem.*, No. 55, 1932 and *Geogr. J.*, vol. 81, p. 573). As to the extra-tropical lands it is a misrepresentation to state that the maritime winds are prevented from reaching the interior. The very fact that the continental areas have relatively low pressure over them in summer means that their air supply is drawn from outside and that maritime currents do penetrate the interior irregularly giving seasonal summer rainfall in association with small shallow barometric depressions.

The reason why the equatorial rain-belt is not broader is a highly complicated dynamical question involving the stabilization of the Trade winds which feed it, and cannot be fully explained at present. It must be remembered, further, that nowhere is the doldrum belt quite free from local modifications. Thus in Africa the equatorial rain-belt is greatly enhanced by local summer monsoons in the west, and almost suppressed by the Asiatic summer monsoon system in the east. Whether the heated Sahara exerts any local action either in arresting or promoting the northward summer swing of the rain-belt cannot be answered from theory as either effect is possible; but the question has been recommended for investigation in connection with the meteorological aspects of the Africa Research Survey which will shortly issue a preliminary report.

GEOGRAPHY IN BRAZIL

An "Associação dos Geografos Brasileiros" has recently been formed at São Paulo, in connection with the department of geography at the University. The chair of geography is now occupied by Professor Pierre Deffontaines, to whom the initiative in the foundation of the Association is largely due. We have recently received the first three numbers of the Association's publication *Geografia*, which is designed to bring home to a wider circle of the Brazilian public the importance of geography in their national life. So far, as is perhaps natural, the articles published have dealt with the State of São Paulo, but as the publication becomes established, this will no doubt be altered. In the first number, Sr. L. F. de Moraes Rego outlines the geographical factors which must be considered in analysing the soil types of the State, and puts forward a tentative physiographic division. This number also contains an interesting summary of the organized Japanese immigration into Brazil. The total number of immigrants in São Paulo State in 1935 was 150,000, most of whom had arrived in the previous ten years. It appears that a large proportion are settling permanently, mainly as manual workers. In the second number, Professor Deffontaines attempts a regional division of the State; he points out that the transitory character of much of the settlement in the past has prevented the development of well-defined regions. The last number received contains an article by C. Prado Junior on the geographical factors in the growth of the city of São Paulo. It will be seen that this publication promises to be of considerable value to students of the geography of Brazil: no doubt in time its scope will reach beyond the bounds of its own state.

OBITUARY

MAY FRENCH SHELDON

Born in America in 1848, Mrs. French Sheldon travelled three times round the world and was the first white woman to undertake an independent exploration of Central Africa. Close on half a century ago, just at the time when the world was being thrilled by the chronicles of Stanley's adventurous exploits, "In Darkest Africa," news of the journey of Mrs. French Sheldon from Mombasa to Mount Kilimanjaro unaccompanied by any white companion came as an astonishing tale of intrepid courage and daring. For months she lived and journeyed alone, save for her native porters to whom she was known as "Bébé Bwana," through East Africa amongst head-hunters and cannibals. It was this expedition, during which she collected a large amount of valuable anthropological and ethnographical information, which established her reputation and enabled her to give to the British Association in 1891 an accurate description of the little-known Lake Chala at the foot of Mount Kilimanjaro. She was one of the twenty-one women elected in 1892 to the Royal Geographical Society, who were for long the only women to be admitted as Fellows of the Society.

In 1894 she began her journeys through the Congo, where her work had the approval of King Leopold, who commanded "that Mrs. French Sheldon shall be the freest and most independent person throughout our Congo domain. She shall not be denied free access to any documents, and shall be given every opportunity of investigating every branch of all work done by natives at all times by officers in command."

Soon after the outbreak of war she went to America, and by means of lectures and social functions raised large sums of money for the Belgian Red Cross. For those services, and for her work in the Belgian Congo, the late King Albert conferred upon her the honour of Chevalier de l'Ordre de la Couronne of Belgium.

MEETINGS: SESSION 1935–36

Eighth Evening Meeting, 3 February 1936. The President in the Chair

Elections: Miss Edith Benton, B.A.; Mrs. Adelaide Buttle; Miss Jane Kerr Colquhoun; Captain Cuthbert H. Dawnay, M.C.; Robert Amherst Tyssen-Gee; William Ignatius Gomes; John Graham Fielding Hall; Tom H. Harrisson; Miss Aileen McMahon; Mohammed Mitwally; Miss Rosie Neumann; Charles Arthur Peake; D. W. Ravenhill; Walter Johannes Stein, PH.D.; Dudley Bulmer Toye, O.B.E., LL.D., F.R.HIST.S.; H. Bradford Washburn; Roland Sylvester Dennis Williams, B.A.

Paper: The Harvard-Dartmouth Alaskan Expeditions, 1932–34. By Mr. Bradford Washburn

Third Afternoon Meeting, 6 February 1936. The President in the Chair

Paper: Seismic Survey of the Crillon Glacier. By Mr. Richard P. Goldthwait

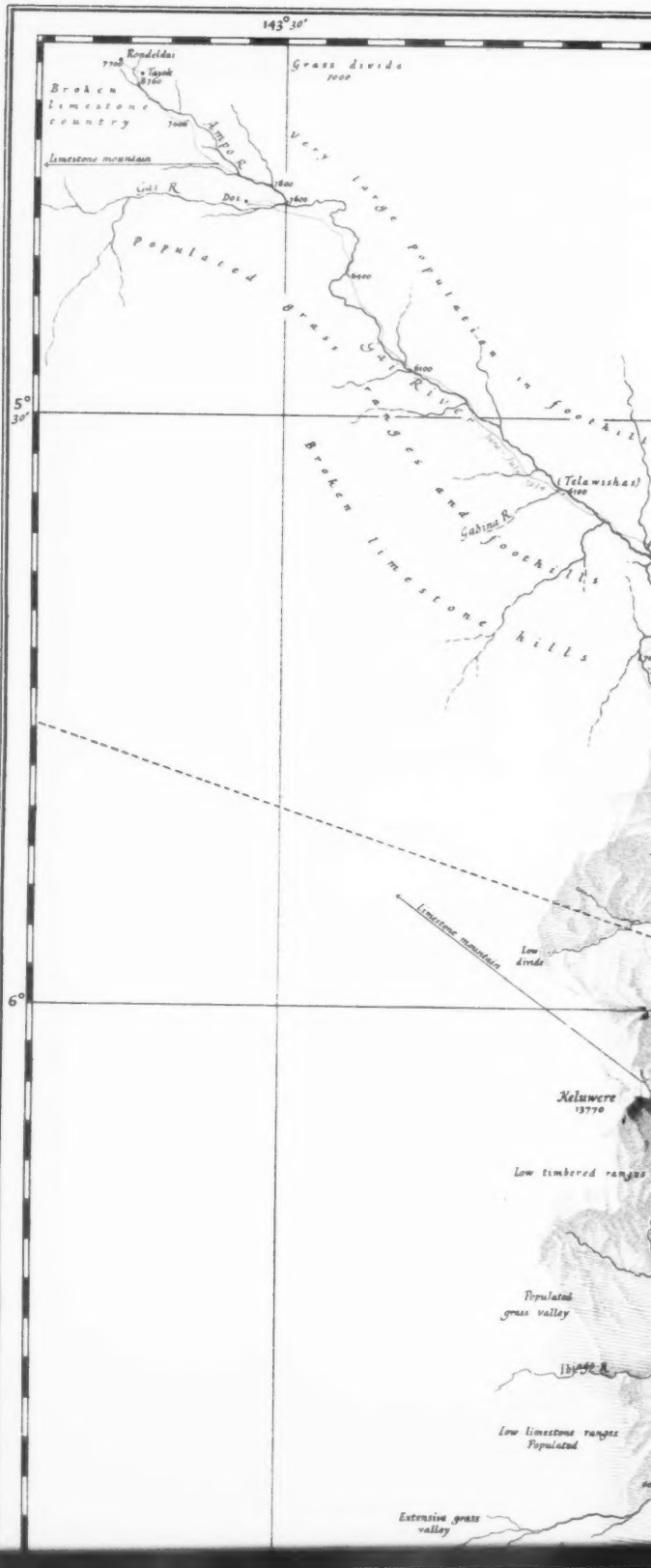
Fourth Afternoon Meeting, 10 February 1936. The President in the Chair

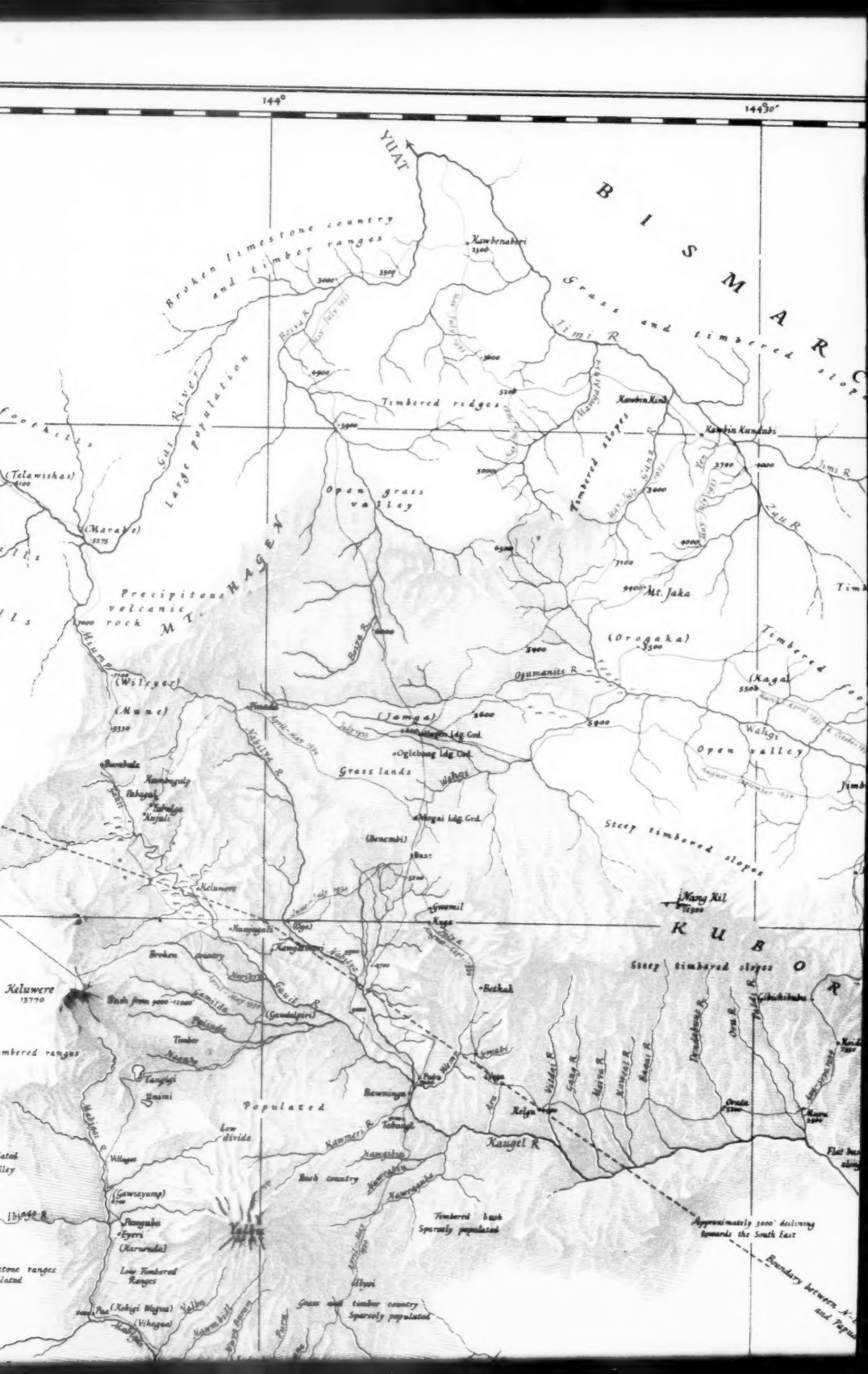
Paper: The Glaciation and Solifluction of Minya Gongkar. By Professor Arnold Heim

Ninth Evening Meeting, 17 February 1936. The President in the Chair

Elections: Charles Godfrey Bird; P. E. Laughton Bramley; Harold Lionel Cohen, M.A.; Mrs. Mollie Courtauld; Roger Clarke Dolbey, M.A.; Maxwell John Dunbar; Miss Florence Gouk, B.SC.; Chauncy Dennison Harris; Henry O'Brien Frederick Hayward; R. A. Hodgkin; William Livingston, A.M.INST.C.E.; J. C. Ryle; Sardar Bahadur Mohan Singh; Miss Elizabeth Eileen Synge; William J. Talbot, B.SC.

Paper: A Four-Year Trail from Alaska to the Mackenzie Delta. By Mr. Erling Porsild


143° 30'
Rondelda
7500
Tayak
8100
Broken limestone country
7000
Limestone mountain
Grass divide
7000
Very large Population in foothills
Gabina R
Dai
7800
Populated
Grass
Gabina R
6000
5° 30'
Broken limestone hills
Telawishas
8100
Gabina R
Limestone mountain
Low divide
6°
Keluwere
13770
Low timbered ranges
Populated grass valley
Low limestone ranges Populated
Extensive grass valley


144°
144°30'
YUAT
BISMARC
Broken limestone country and timber ranges
Grass and timbered slop
Kawbenaheri 3500
Timbered ridges
Timbered slopes
Kawbin Kundubi
Open grass valley
Large population
Cult River
Precipitous volcanic rock
MT. HAGEN
Mt. Jaka
(Orogaka)
Timbered
Ogumanits R.
(Kaga)
Walgi
Open valley
(Jamaga)
Ogiebong Ldg Grd.
Grass lands
Mogai Ldg Grd.
Steep timbered slopes
Nang Kil
KUBO
Keluwere
Broken country
Bush from 9000-12000
Timber
Populated
Low divides
Kaugel R.
Bush country
Timbered bush
Sparsely populated
Approximately 300° declining towards the South East
Low Timbered Ranges
Grass and timber country
Sparsely populated
Boundary between

145°

NEW GUINEA

The Headwaters of
THE PURARI AND YUAT RIVER

Scale 1/600000

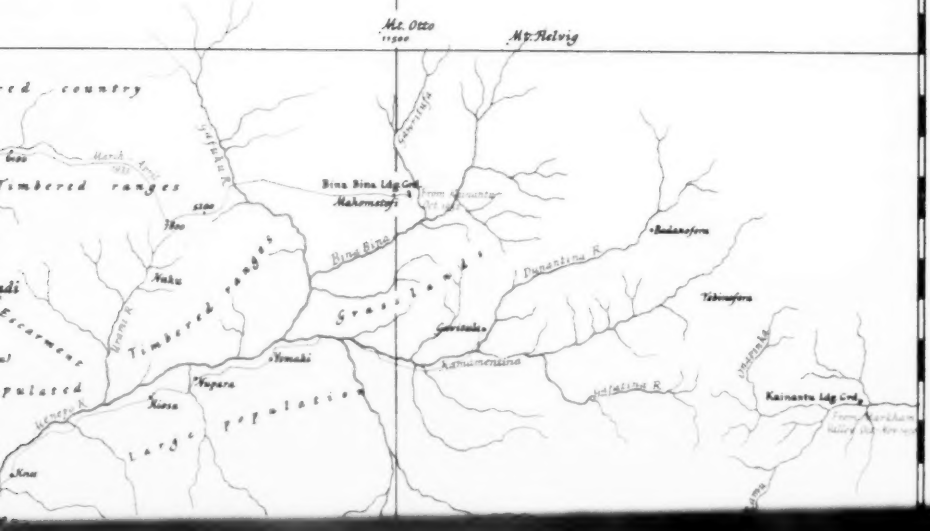
Miles 5 0 5 10 15 20

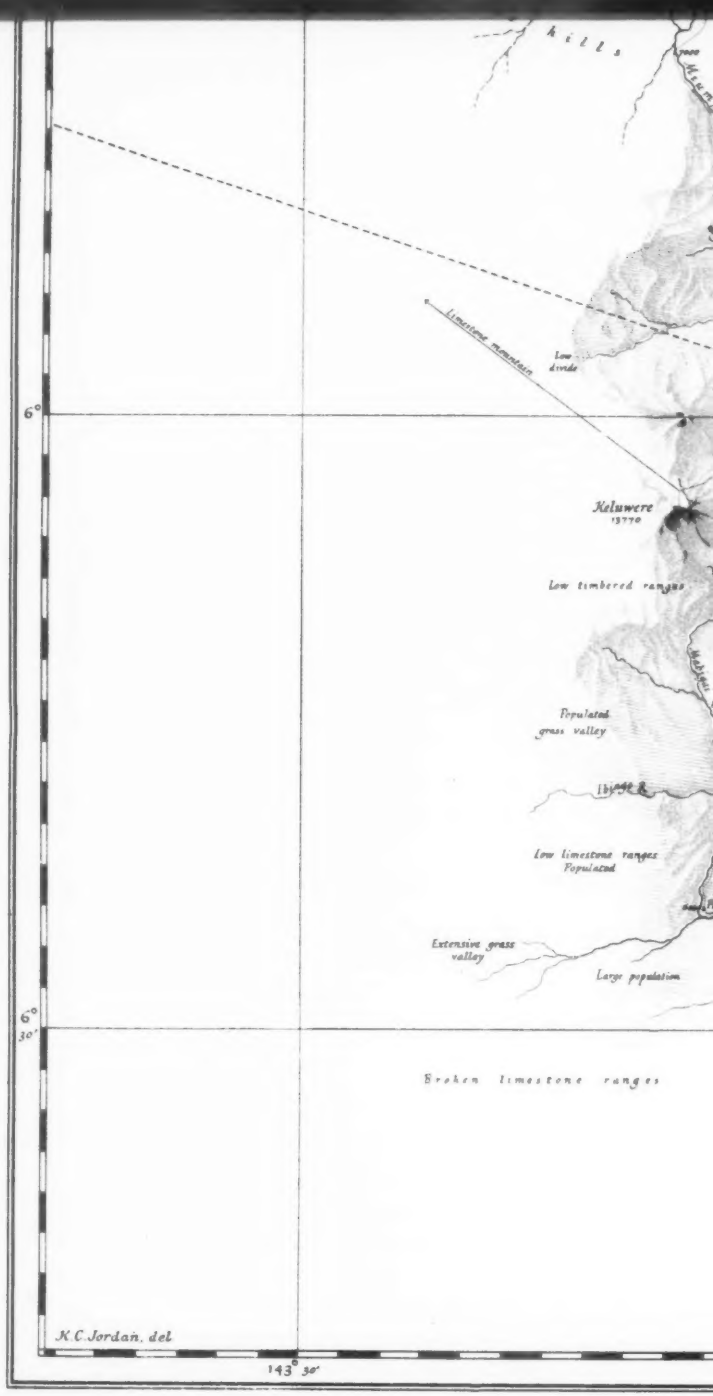
Kilometres 5 0 5 10 15 20 25 30

Route ——— *Native village* • *Ldg Grd* ... *Landing Ground*
Tribal names in brackets. Heights in feet from aneroid readings.

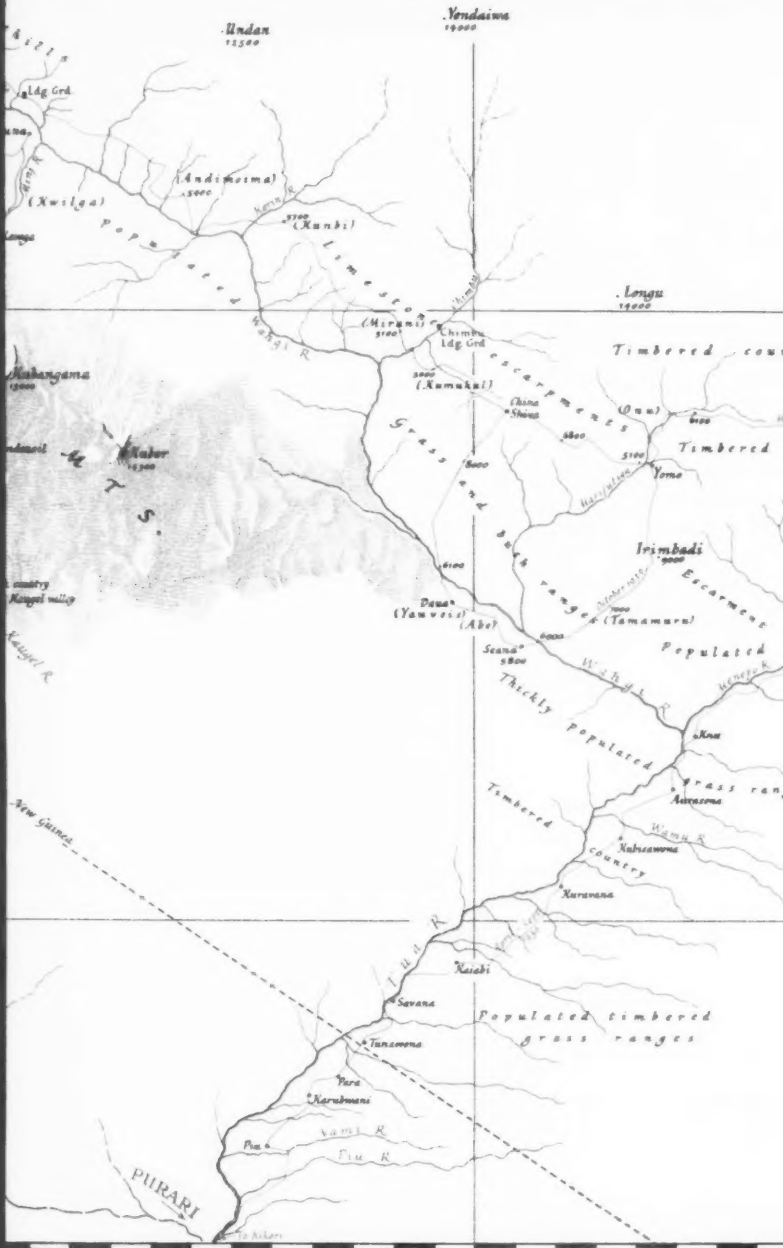
RIVERS

Scale 1/6 000 000
144°
146°
148°
4°
6°
8°
Sepik R.
Yuat R.
Schrader
Kaka I.
Madang
Long I.
Umboi I.
N. E. NEW GUINEA
Ramu R.
Wahgi R.
Purari Plateau
Kratke Ra.
Markham
Area of map
Lae
Salamaua
Kikori R.
Purari
Kikori
Wau
Morobe
Port Romilly
Karema
Gulf of Papua
Daru
Kokoda
Owen Stanley Ra.
Port Moresby


Mt. Otto
11500
Mt. Helvig
6°
Timbered ranges
Bina Bina Ldg Grd
Bina Bina
Grassland
Timbered ranges
Large population
Kainantu Ldg Grd


Hills
Limestone mountains
Low divide
Keluwere
1377 ft
Low timbered ranges
Populated grass valley
Low limestone ranges Populated
Extensive grass valley
Large population
Broken limestone ranges
6°
6° 30'
K.C. Jordan, del.
143° 30'

volcanic
rock
(Wolgeo)
(Mune)
Grass lands
Steep timbered slopes
Open valley
Broken country
Bush from 5000-11000
Timber
Populated
Low divide
Bush country
Timbered bush
Sparsely populated
Low Timbered Ranges
Grass and timber country
Sparsely populated
Rugged timber ranges
Large population
Grass country
Approximately 5000' declining towards the South East
Boundary between
and
K U B O R
144°
144°30'



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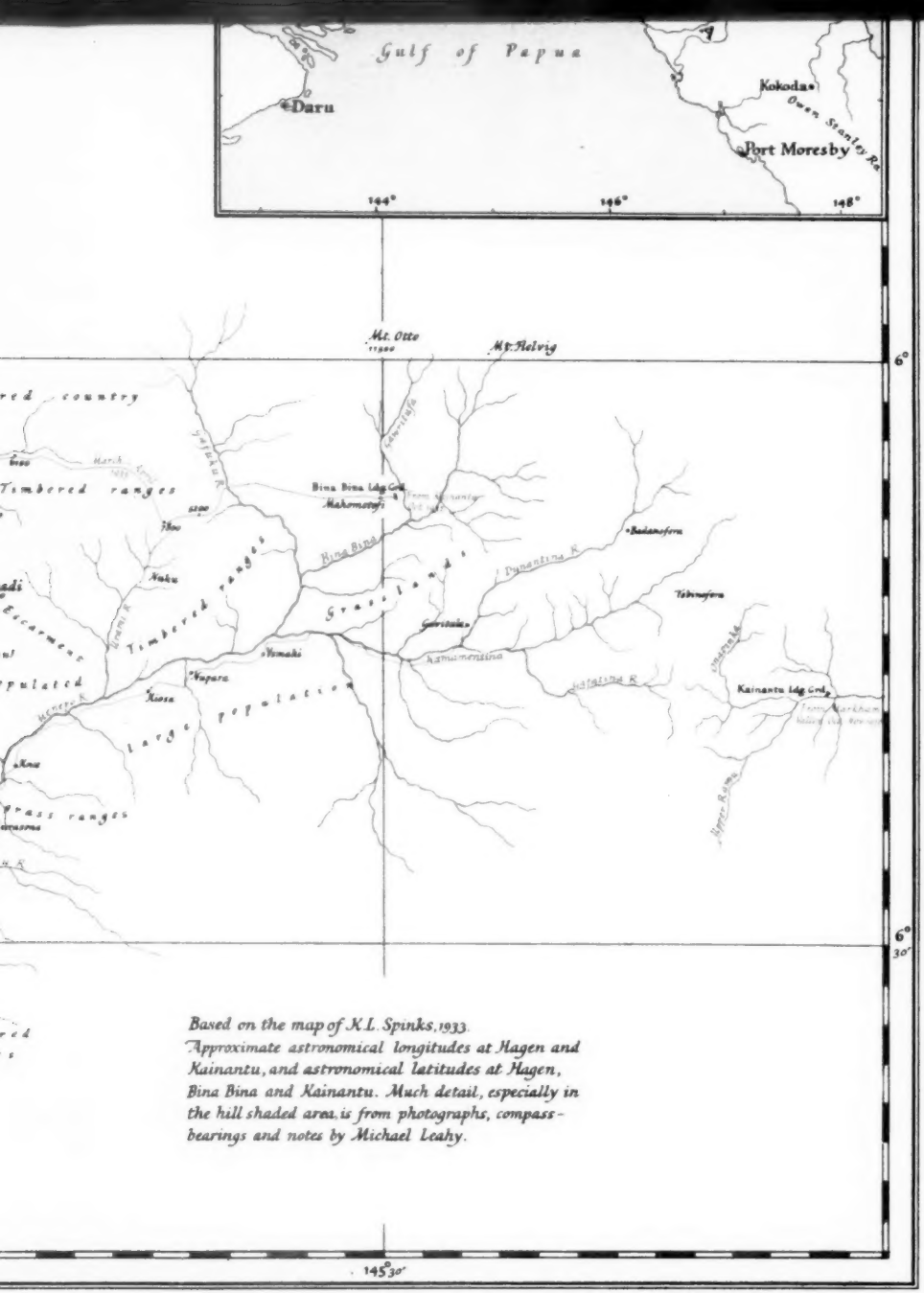

Based on the map of K.L. Spinks, 1933.
Approximate astronomical longitudes at Hagen and Kainantu, and astronomical latitudes at Hagen, Bina Bina and Kainantu. Much detail, especially in the hill shaded area, is from photographs, compass-bearings and notes by Michael Leahy.

N.E. NEW GUINEA & PAPUA
Spinks. Leahy